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HAER Level II Documentation of Launch Complexes 1/2, 3/4, 9/10, 14, and 34 at Cape Canaveral Air Force Station, Florida

Susan I. Enscore and Martin J. Stupich

June 2016

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Construction Engineering Research Laboratory

Cover Photo: Detail of Blockhouse, Launch Complex 14, Cape Canaveral Air Force Station, Florida (ERDC-CERL, 2014).

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Final report

Prepared for 45th Civil Engineer Squadron (CES/CE)
1211 S Patrick Dr
Patrick Air Force Base, FL 32925-3622

Under Project DBEH147201, “Update Historic American Buildings Survey/Historic American Engineering Records,” MIPR F2MUAA3326G002

Abstract

This report presents Historic American Engineering Record (HAER) Level II documentation of Launch Complexes 1/2, 3/4, 9/10, 14, and 34, Cape Canaveral Air Force Station (CCAFS), Florida. These facilities have played an important role in the American missile and manned space programs that began largely as a result of the Cold War. As the "arms race" expanded in the 1950s and 1960s, missile systems with increasing range and destructive power were deployed on both American and foreign soil. To bring these systems to operational readiness, long and complicated testing programs were necessary and required specialized facilities to support them. A national effort to put men on the surface of the moon also required specialized facilities at Cape Canaveral. These five complexes were constructed in the 1950s and early 1960s, with Launch Complexes 1/2, 3/4, and 9/10 used exclusively for rocket and missile testing, and Launch Complexes 14 and 34 also used for manned spaceflight. Launch Complexes 14 and 34 are part of the Cape Canaveral Air Force Station National Historic Landmark District established in 1984.

Preface

This study was conducted for the 45th Civil Engineer Squadron, Patrick Air Force Base, under Project DBEH147201, "Update Historic American Buildings Survey/Historic American Engineering Records." Funding was provided through MIPR F2MUAA3326G002. Technical monitoring for the project was provided by Thomas E. Penders, 45th Space Wing Cultural Resources Manager, Patrick Air Force Base.

The work was performed by the Land and Heritage Conservation Branch (CNC) of the Installations Division (CN), U.S. Army Engineer Research and Development Center – Construction Engineering Research Laboratory (ERDC-CERL). At the time of publication, Dr. Michael Hargrave was Chief, CEERD-CNC; and Ms. Michelle Hanson was Chief, CEERD-CN. The Deputy Director of ERDC-CERL was Dr. Kirankumar Topudurti, and the Director was Dr. Ilker Adiguzel.

The authors are grateful for assistance with this report from Mr. Thomas E. Penders, 45th Space Wing Cultural Resources Manager, Patrick Air Force Base, Florida. Assistance was also provided by William Stoeckel, Tammy Killian, and Kimberly Osgood, 45th Space Wing Real Property Office; and Emily Perry and staff at the U.S. Air Force Space and Missile Museum.

COL Bryan S. Green was the Commander of ERDC, and Dr. Jeffery P. Holland was the Director.

Unit Conversion Factors

Multiply	By	To Obtain
acres	4,046.873	square meters
cubic feet	0.02831685	cubic meters
degrees (angle)	0.01745329	radians
feet	0.3048	meters
inches	0.0254	meters
gallons (US liquid)	3.785412 E-03	cubic meters
horsepower (550 foot-pounds force per second)	745.6999	watts
miles (U.S. statute)	1,609.347	meters
miles per hour	0.44704	meters per second
pounds (mass)	0.45359237	kilograms
pounds (force) per inch	175.1268	newtons per meter
square feet	0.09290304	square meters
square inches	6.4516 E-04	square meters
square miles	2.589998 E+06	square meters
square yards	0.8361274	square meters

Abbreviations

Term	Meaning
AAF	Army Air Forces
AFB	Air Force Base
CCAFS	Cape Canaveral Air Force Station
CO_2	carbon dioxide
CRM	Cultural Resources Manager
ERDC-CERL	Engineer Research and Development Center–Construction Engineering Research Laboratory
GIS	geographic information system
GN_2	Gaseous nitrogen
HABS	Historic American Building Survey
HAER	Historic American Engineering Record
ICBM	intercontinental ballistic missile
IRBM	intermediate range ballistic missiles
KSC	Kennedy Space Center
LC	launch complex
LOX	liquid oxygen
MFL	Missile Firing Laboratory
MIPR	Military Interdepartmental Purchase Request
MTTP	multi-service tactics, techniques, and procedures
NASA	National Aeronautics and Space Administration
NHPA	National Historic Preservation Act
NRHP	National Register of Historic Places
POL	petroleum, oil, and lubricants
PTU	propellant transfer unit
RP-1	Kerosene-based rocket fuel
USAF	U.S. Air Force
USGS	U.S. Geological Survey

Introduction

Background

Congress codified the National Historic Preservation Act of 1966 (NHPA), the nation's most effective cultural resources legislation to date, in order to provide guidelines and requirements for preserving tangible elements of our nation's past. This preservation was done primarily through creation of the National Register of Historic Places (NRHP). Contained within the NHPA (Sections 110 and 106) are requirements for federal agencies to address their cultural resources, which are defined as any prehistoric or historic district, site, building, structure, or object. Section 110 requires federal agencies to inventory and evaluate their cultural resources. Section 106 requires the determination of the effect of federal undertakings on properties deemed eligible or potentially eligible for the NRHP.

Objective

This project will provide the Cape Canaveral Air Force Station (CCAFS) Cultural Resource Manager (CRM) with recordation to Historic American Engineering Record (HAER) Level II standards of five Launch Complexes (1/2, 3/4, 9/10, 14, and 34). Analysis and the resulting documentation will (1) provide valuable information towards understanding the role of these launch complexes to CCAFS, the Air Force, the Department of Defense missile programs, and the NASA manned space program; and (2) potentially mitigate future undertakings on the complexes, in fulfillment of agreement(s) to that effect with the Florida State Historic Preservation Officer (SHPO).

Approach

Project funding

Under a Military Interdepartmental Purchase Request (MIPR), the Engineer Research and Development Center-Construction Engineering Research Laboratory (ERDC-CERL) was retained by the 45th Civil Engineering Squadron, Patrick Air Force Base, Florida, to complete existing HAER Level II documentation for Launch Complexes 1/2, 3/4, 9/10, 14, and 34.

Research design

There have been ongoing efforts to document launch complexes at CCAFS to the standards of HAER. HAER documentation efforts for the five Launch Complexes documented in this study were first begun in the late 1990s by Archaeological Consultants, Inc. of Sarasota, FL, but never finalized. The tasks for this project were to bring the existing drafts up to date, format the documentation to HAER Level II guidelines, and produce large-format photography to HAER specifications for Launch Complexes 1/2, 3/4, 9/10, 14, and 34.

The team conducted field work in 2014 to gather information on the launch complexes and to produce the large-format photographs. Dr. Susan I. Enscore, Project Historian and Project Manager, updated and formatted the textual documentation materials, and prepared the documentation packages for transmittal to the HAER collection. Mr. Martin Stupich served as project photographer and archival technician.

Each launch complex's HAER documentation is reproduced in the pages that follow this introduction, done in the required HAER format. Sources consulted and referenced are listed in a bibliography at the end of each launch complex's documentation. Each section contains three parts: (1) historic context, (2) architectural description, and (3) historic and current photographs.

A separate, final submission to the Historic American Building Survey (HABS)/HAER collection at the Library of Congress will be done on archival paper, accompanied by archival prints and negatives.

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CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 1/2 HAER No. FL-8-8
Northern terminus of Bumper Road (Lighthouse Road)
Cape Canaveral
Brevard County
Florida

PHOTOGRAPHS
WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
Southeast Regional Office
National Park Service
U.S. Department of the Interior
100 Alabama Street, S.W.
Atlanta, GA 30303

HISTORIC AMERICAN ENGINEERING RECORD

CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 1/2

HAER No. FL-8-8

Location:	Northern terminus of Bumper Road (Lighthouse Road) 0.2 miles north of intersection with Central Control Road Cape Canaveral Brevard County Florida USGS Cape Canaveral Quadrangle, Universal Transverse Mercator Coordinates: 17.545298.3148858
Date of construction:	1951–1953
Engineer:	Parsons Aerojet Company
Present owner:	U.S. Air Force
Present Use:	Deactivated
Significance:	Constructed between 1951 and 1953, Launch Complex 1/2 at Cape Canaveral Air Force Station played a significant role in the larger missile research and development program that provided the United States with an operational, conventional, and nuclear missile force for defense in the arms race. Launch Complex 1/2 was constructed and used throughout the 1950s for the Snark and Matador winged cruise missile programs. Although technologically simple compared to subsequent facilities, Launch Complex 1/2 was at the forefront of scientific design at the time of its construction. As a military facility, the complex was subsequently modified to act as a heliport in support of the Mercury manned launches and later for use as part of the Tethered Aerostat Radar System.
Report prepared by:	Kimberly Hinder Architectural Historian, Archaeological Consultants, Inc. 8110 Blaikie Court, Suite A, Sarasota, Florida 34240 Updated - Dr. Susan Enscore U.S. Army Engineer Research and Development Center- Construction Engineering Research Laboratory 2902 Newmark Drive, Champaign, IL 61822
Date	May 2003 (updated by Dr. Enscore February 2016)

HISTORICAL OVERVIEW OF CAPE CANAVERAL AIR FORCE STATION

Rocketry in the United States originated with the pioneering work of Robert H. Goddard, who launched the first liquid-propelled rocket in 1926. Across the Atlantic, German engineers were simultaneously developing their own rocket science program. Encouraged by the Nazi regime during World War II, the Germans developed the V-1 "buzz bomb" and the V-2 ballistic missiles which they used against Allied cities in 1944. Although the Allied forces had experimented with missiles powered by rocket engines, they lacked the technology to compete with the V-2 against which there was little defense. As a result, the U.S. Army, Navy, and Air Force each initiated their own missile programs to fulfill their particular roles in national defense.

Following the war, the U.S. Army brought 115 German rocket engineers and scientists, including Dr. Wernher von Braun, to the United States to develop their program. These engineers conducted experiments to refine the German V-2 and develop long-range surface-to-surface guided missiles. Initially stationed at Fort Bliss, Texas, the team assisted the Army in testing rockets at the White Sands Proving Grounds beginning in May 1946. This site, however, was geographically constrained and posed a danger to civilians when rockets misfired.[1]

Increasingly concerned with Soviet missile and nuclear development after World War II, the Department of Defense created and charged the Committee on Long Range Proving Grounds to select a suitable missile test site in October 1946. Cape Canaveral was selected for several critical reasons. Missiles could be launched over the Atlantic Ocean and tracked from islands. The isolated location of the Cape enhanced security for research and development. The government already owned land at the Cape, and the undeveloped nature of the remaining land made it less expensive to acquire. The launch area was accessible via water, easing the transportation logistics of heavy rockets and building supplies. The warm weather also allowed year round operation of a missile site at the Cape.[2]

Until July 1947, the United States' military air forces were part of the Army (known as the Army Air Forces or AAF since 1941). The National Security Act of 1947 divided the military services into the three separate departments: the Army, the Navy, and the Air Force. In 1949, President

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[1] Charles D. Benson and William B. Faherty, *Moonport: A History of Apollo Launch Facilities and Operations* (National Aeronautics and Space Administration, Scientific and Technical Information Office, 1978; reprint as *Gateway to the Moon: Building the Kennedy Space Center Launch Complex* and *Moon Launch! A History of the Saturn-Apollo Launch Operations*, Gainesville: University Press of Florida, 2001), 1 (page references are to reprint edition).

[2] David Barton and Richard S. Levy, *An Architectural and Engineering Survey and Evaluation of Facilities at Cape Canaveral Air Force Station, Brevard County, Florida* (Resource Analysts, Inc., 16 March 1984), 3-4; Benson and Faherty, 4.

Harry S. Truman signed legislation which established the Joint Long Range Proving Ground at Cape Canaveral, with Patrick Air Force Base (originally the Banana River Naval Air Station) selected as the support base. Although the entire facility was initially under the cooperative use of the Army, Navy, and Air Force, the Air Force, by a directive of the Department of Defense, ultimately assumed responsibility for the range. The Joint Long Range Proving Ground was renamed the Air Force Missile Test Center, the first of many subsequent name changes. Although the Army continued its operation of the White Sands Proving Grounds in New Mexico and the Navy continued to fund its missile testing center at Point Mugu, California, both military branches continued to play an active role at Cape Canaveral.[3]

Construction and Missile Development at Cape Canaveral

Between April and June of 1950, land was acquired at the Cape through negotiation and condemnation proceedings. During this period, the U.S. Army Corps of Engineers was designated as the construction agency. The Jacksonville District of the Corps opened an office at Patrick Air Force Base in 1950 to oversee construction at Patrick Air Force Base and the Air Force Missile Test Center at Cape Canaveral. By December 1950, the office had managed $2.4 million of construction contracts. For each construction project, the agency (Army, Navy, Air Force) would submit to the Corps specifications, a completion deadline, and authorization to begin construction. The Corps would then negotiate and award a contract to an architectural/engineering firm for preparation of construction plans. Once the plans were submitted, the Corps advertised and selected a contractor who had to complete the project within the time frame or pay penalties.[4]

As the United States entered peacetime and reduced military funding during the late 1940s, the various branches of the military sought to determine their roles in missile research and design. The Army continued refining the German V-2, with the assistance of the team led by Wernher von Braun and 300 carloads of V-2 missile components seized during World War II. The Army conducted the first successful launch at Cape Canaveral on July 24, 1950. An Army-General Electric Corporation-California Institute of Technology team launched Bumper No. 8, a modified V-2 rocket, from Launch Pad 3. The Army team continued to use Pad 3 to conduct additional launches through 1951.[5]

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[3] E.R. Bramlitt, *History of Canaveral District 1950-1971*, (South Atlantic Division, U.S. Army Corps of Engineers, 1971), 1-2; Benson & Faherty, 3, 7.

[4] Bramlitt, 1-2, 33.

[5] Benson & Faherty, 1, 6-7.

During the late 1940s and early 1950s, Air Force activities at Cape Canaveral focused on winged cruise missile research and development as a deterrent force in the weapons race between the United States and the Soviet Union. Constrained by a reduced budget, the Air Force chose to fund research and testing on the cruise missile, projected to be operational before the ten years anticipated for the development of the ballistic missile. These winged missiles resembled unmanned airplanes and fell into four different categories: air-to-air, air-to-surface, surface-to-air, and surface-to-surface. These missiles were restricted to the Earth's atmosphere because they required oxygen for engine combustion. The earliest launch pads, used for firing experimental winged missiles including the Lark, Matador, Snark, Bomarc, Bull Goose, and Mace, were located at the tip of the Cape, and included Launch Complexes 1 & 2, 3 & 4, 9 & 10, and 21 & 22. Support buildings, including a communications building, a water plant, a fire fighting unit, electrical substations, a skid strip for the landing and reuse of the missiles, and Hangars C and O, were constructed near the original launch pads. As explosive power increased, and missiles necessarily grew larger, support activities were relocated farther from the launch pads to an Industrial Area which was situated along the western shore of the Cape.[6]

After the Soviets detonated their first atomic device in 1949 and following the outbreak of war in Korea in 1950, the United States government reassessed the military cutbacks of the late 1940s. With increased funding and the development of relatively lightweight nuclear warheads, the Air Force and Army decided to pursue ballistic missile research and development. Faster and more accurate than the winged cruise missiles, ballistic missiles, with their own oxygen source, could leave the Earth's atmosphere. The ballistic missiles were divided into two categories based on the distance they could travel. The intercontinental ballistic missiles (ICBMs) had a range of over 5,000 miles. Intermediate range ballistic missiles (IRBMs) had a range of 1,500 miles. The Air Force, which remained focused primarily on the development of cruise missiles, initiated a ballistic missile study which resulted in the Atlas missile.[7]

To advance its research and development of ballistic missiles, the Army Ballistic Missile Agency moved their team of German engineers from Fort Bliss, Texas, to the Redstone Arsenal in Huntsville, Alabama. Soon after the move to Huntsville, the launch team, known as the Missile Firing Laboratory (MFL), established facilities at Cape Canaveral. With the first launch of the Redstone missile on August 20, 1953 at Launch Pad 4, the MFL inaugurated the testing of ballistic mis-

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[6] Barton and Levy, 6, 25; Bramlitt, 5-8; Jacob Neufeld, *The Development of Ballistic Missiles in the United States Air Force, 1945*-1960, (Washington, D.C.: Office of Air Force History, United States Air Force, 1990), 239.

[7] Neufeld, 98, 241; Benson and Faherty, 1, 3, 7.

siles, an event which foreshadowed the construction of numerous launch facilities for ballistic missiles at the Cape.[8]

Both the detonation of the first thermonuclear device in 1952 and intelligence reports indicating that the Soviet Union was developing long-range missiles and thermonuclear warheads led to advancements in ballistic missile development. In 1953, the Air Force formed a panel of U.S. scientists to examine their Snark, Navaho, and Atlas missile programs. The panel recommended accelerating development of the Atlas ICBM.[9] By 1955, Air Force officials convinced President Eisenhower to assign the ICBM development program the highest national priority. Accordingly, the Air Force initiated programs for the design and testing of the ICBM Titan in 1955 and the ICBM Minuteman in 1958. As the Air Force ICBM program grew, intelligence reports indicated that the Soviet Union would have ICBMs with nuclear warheads operational by 1960. Fearing that the United States could not match the Soviet ICBM threat, the Department of Defense decided to fund the development of IRBMs because they would be operational sooner and would act as a deterrent based out of Europe. In 1955, the Department of Defense approved two IRBM programs, the Air Force Thor and the Army/Navy Jupiter, which developed simultaneously and were assigned an equal national priority as the ICBM programs.[10]

The constant drive to develop more accurate and powerful weapons during the Cold War led to the construction of numerous launch complexes along the Cape. Although many of the early launch complexes were adapted to new uses as support structures, complexes constructed for one type of missile were rarely reused to launch another type of missile because they were not configured structurally, electronically, or for safety concerns for the new larger and more powerful missile. Economically, it was more cost effective to design and build a new complex than to reconfigure and adapt an old complex. Explosive hazards, the dangers of launching over other complexes or inhabited areas, and maintaining a line of site between the launch vehicle and the launch control center (blockhouse) determined the choice of sites and distance between launch complexes. Each missile had similar ground requirements at the launch complex including a launch pad, a gantry service tower, a blockhouse for on-site command and control of the launch,

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[8] Benson and Faherty, 1, 3, 7.

[9] Neufeld, 98-103; David N. Spires, "The Air Force and Military Space Missions: The Critical Years, 1957-1961," in *The U.S. Air Force in Space: 1945 to the 21st Century*, Proceedings Air Force Historical Foundation Symposium, Andrews AFB, Maryland, September 21-22, 1995, ed. R. Cargill Hall and Jacob Neufeld (Washington, DC: USAF History and Museums Program, United States Air Force, 1998), 34–35.

[10] Ibid., 143–48, 242.

and a network of power, fuel, and communication links.[11] The government maintained programs for both ICBMs and IRBMs concurrently and facilities for both types of missiles were constructed at Cape Canaveral. Over time, the area south of the tip was developed for launching IRBMs (Redstone, Pershing, Polaris/Poseidon, and Thor) and included launch complexes 5 & 6, 17, 18, 25, 26, 29, and 30. The area north of the tip was developed for launching ICBMs and space launch vehicles (Atlas, Titan, Saturn) and included complexes 11, 12, 13, 14, 15, 16, 19, 20, 34, 36, and 37.[12]

Throughout the early and mid-1950s, the focus of activities at Cape Canaveral remained on missile development for defense against the Soviets. In November 1956, the Secretary of Defense divided the responsibilities for research and development of missiles among the armed forces. The Air Force received responsibility for all intermediate and long-range missiles, both IRBMs and ICBMs, while the Army was restricted to missiles with a range of 200 miles or less. The Navy was limited to developing submarine and ship-based IRBM missile systems.[13]

Cape Canaveral and the United States Space Program

In 1955, President Eisenhower announced that the United States would launch an unmanned satellite as part of the nation's participation in the International Geophysical Year which extended from July 1957 through December 1958. The Army, Navy, and Air Force immediately initiated planning for their own satellite programs.[14] When the Soviets launched the satellite Sputnik I in October of 1957, the attention of the public turned to space exploration. The following month, the Soviets placed the Sputnik II satellite carrying a dog into orbit around the Earth. The launch caused a furor among Americans who feared that the U.S. was losing not only the "space race," but also that a "missile gap" existed between the U.S. and the Soviets, who it was believed had hundreds of operational ICBMs. The President initially assigned responsibility for the U.S. space program to the Department of Defense. The Army's Development Operations Division led by

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[11] Benson and Faherty, 8-10.

[12] Barton and Levy, 4, 9; Denise P. Messick, Cynthia G. Rhodes, and Charles E. Cantley, *45th Space Wing Cultural Resource Management Plan*, Technical Report No. 386 (Stone Mountain, Georgia: New South Associates, 1996), 95; James N. Gibson, *Nuclear Weapons of the United States: An Illustrated History* (Atglen, PA: Schiffer Publishing, Ltd., 2000); Hartmann 2003.

[13] Neufeld, 242; Barton and Levy, 17.

[14] R. Cargill Hall, "Civil-Military Relations in America's Early Space Program," in *The U.S. Air Force in Space: 1945 to the 21st Century*, Proceedings Air Force Historical Foundation Symposium, Andrews AFB, Maryland, September 21–22, 1995, ed. R. Cargill Hall and Jacob Neufeld (Washington, DC: USAF History and Museums Program, United States Air Force, 1998), 25.

von Braun shifted their focus to the use of missiles to propel payloads, or even a man, into space.[15] After several failures on the launch pad, the United States entered the space race with the launch of the Army's scientific satellite Explorer I on January 31, 1958 using a four stage Jupiter C missile named Juno I. With the threat of a growing fleet of operational Soviet ICBMs, the branches of the U.S. military initiated the development of photographic reconnaissance satellites which were operational by 1960.[16]

Realizing that the military's involvement in the space program would jeopardize the goal of using space for peaceful purposes, the President's Science Advisory Committee urged that a centralized agency be created to oversee the scientific exploration of space. The new agency, the National Aeronautics and Space Administration (NASA), established October 1, 1958, was to be a civilian agency with the mission of carrying out scientific aeronautical and space exploration, both manned and unmanned. The Department of Defense, especially the Air Force, would continue with defense related missile and satellite development.[17] Soon after the creation of NASA, Navy personnel and facilities associated with Project Vanguard and over 400 scientists from the Naval Research Laboratory were reassigned to NASA. The California Institute of Technology's Jet Propulsion Laboratory, affiliated with the Army, was also transferred to NASA. Initially working with NASA as part of a cooperative agreement, President Eisenhower officially transferred a large portion of the Army's Development Operations Division with the team led by Wernher von Braun to NASA in March 1960. At the same time, Eisenhower named the Huntsville NASA installation the Marshall Space Flight Center, and designated the MFL at Cape Canaveral as the Launch Operations Directorate of NASA. The Launch Operations Directorate, led by Dr. Kurt Debus, managed the overall integration, testing, and the launch operations of NASA.[18]

NASA soon organized a National Launch Vehicle Program to identify and analyze which missiles would be the most effective in exploring space. As a result, the Scout, Thor (Delta), Atlas, Titan, and Saturn, and modified versions of these rockets, were selected as boosters for manned and unmanned missions. Unmanned activities have included suborbital, orbital, and lunar satellite and vehicular missions to gather scientific information often relating to physics and astrono-

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15 Benson and Faherty, 1-2.

16 Ibid.

17 Hall, 30; Barton and Levy, 20; Spires, 39.

18 Benson and Faherty, 15; Spires, 39.

my. Although some were conducted to prepare for manned launches, most of the missions were intended simply to gain scientific knowledge with which to better understand Earth.[19]

Already upstaged by the Soviets, one of NASA's first goals was to put a man in orbit around the Earth. At its creation, the Air Force's manned space projects were transferred to NASA, which NASA combined under the name Project Mercury in December 1958. NASA selected the first seven astronauts for the manned space program in April 1959. The goals of Project Mercury included sending a man into space to orbit the Earth, testing his ability to perform in a weightless environment, and to recover both man and capsule.[20] The program included two manned suborbital flights powered by a modified Redstone missile and four manned orbital flights powered by an Atlas missile topped by the Mercury capsule. The first suborbital flight occurred on January 31, 1961 with the launch of Ham, a chimpanzee. The United States was again upstaged when the Soviet Union launched Vostock I with cosmonaut Uri Gagarin to orbit the Earth in April 1961. The launch of Alan Shepard the following month on a Mercury suborbital flight proved anticlimactic.[21]

Realizing the impact of the Soviet advancements on the American psyche, President John F. Kennedy appointed Vice President Lyndon Johnson, in cooperation with representatives from NASA and the associated industries, to develop a space program that would surpass the Soviet program. The panel recommended a ten-year phased approach which would include manned space flight, planetary exploration, and the development of new rockets and satellites. Accepting the recommendations, President Kennedy presented the following before a joint session of Congress on May 25, 1961:

> I believe this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the Moon and returning him safely to the Earth. No single space project in this period will be more impressive to mankind, or more important for the long-range exploration of space, and none will be so difficult or expensive to accomplish.[22]

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[19] Barton and Levy, 20-27.

[20] Spires, 39; "Exploring Space...Project Mercury" (U.S. National Aeronautics and Space Administration) 3, Kennedy Space Center Archives, Kennedy Space Center, Sweetsir Collection 95–15, Box 12.

[21] Harry Butowsky, "Man in Space (Reconnaissance Survey) 1903–1981," (Denver: National Park Service, 1981), 4.

[22] Butowsky, "Man in Space," 4–5.

With widespread support, the public and Congress embraced the goal and the program proceeded rapidly. Circling the Earth three times, John Glenn completed the first manned orbital flight of the United States on February 20, 1962 in a capsule propelled by an Atlas rocket from Launch Complex 14. Followed by three more manned orbital flights, the Mercury program concluded as a success on May 15, 1963.[23]

NASA initiated planning for Project Gemini in late 1961 as the intermediate step in sending a man to the moon. Officially announced in 1962, the project was operational by 1964. The goals of Project Gemini included testing man's performance during extended periods in space, both within and outside of the spacecraft, development of rendezvous and docking techniques, and perfection of controlled reentry and landing techniques. The larger, more maneuverable capsule, designed to hold two men, was propelled by a Titan II rocket. Following the first unmanned Gemini launch on April 8, 1964, Gemini 3 was the first manned flight of the program in March 1965. Gemini 12, launched in November 1966, successfully completed the program.

Apollo, the final step in landing astronauts on the moon, immediately followed Project Gemini. Studies to build the Saturn rocket, which would propel man to the moon, actually started in 1957 with the team led by Wernher von Braun under the Army's jurisdiction.[24] Ten times more powerful than the Atlas rocket and twenty times more powerful than the Jupiter, the size and power of the Saturn required the construction of Launch Complexes 34 and 37 at Cape Canaveral. Test flights of the Saturn rocket started at Launch Complex 34 in October 1961. In January 1962, NASA announced that the Saturn would be the moon launch vehicle. The goal of Apollo was to launch a team of three astronauts into orbit around the moon. While one astronaut remained in orbit, the other two would then take an attached spacecraft to land on the moon and then redock with the primary vessel before returning to Earth. The initial missions were Earth orbital (unmanned and manned) followed by lunar missions to orbit and, later, land on the moon.[25]

NASA utilized Launch Complexes 34 and 37 for research and development of the Saturn rocket. Continued modifications to the Saturn to increase its power to propel man to the moon led to a larger rocket with new blast and acoustic hazards. With these factors in mind, combined with the stepped-up launch schedule necessary to land a man on the moon by the end of the decade, it was

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[23] Barton and Levy, 28.

[24] Benson and Faherty, 1–2.

[25] Ibid., 37, 60-64; Barton and Levy, 30–31.

apparent by 1961 that the Apollo program required a new launch complex.[26] Cape Canaveral, with over 22 launch complexes, did not have room for another complex. NASA officials solved the dilemma by acquiring land on Merritt Island, west and north of the existing missile launching area at the Cape. The first acquisitions of land started in 1962, with the majority under federal ownership by 1964. Initially known as the Merritt Island Launch Area, the land was acquired for use predominantly in support of the Manned Lunar Landing Program (Apollo) and was placed under NASA's exclusive jurisdiction. With the new facilities, NASA's offices at the Cape, led by Kurt Debus, expanded and relocated to the Merritt Island Launch Area. The newly independent installation, on par with Marshall Space Flight Center, was renamed the John F. Kennedy Space Center in November 1963 after the death of the president.[27]

During land acquisition and construction of the Kennedy Space Center, NASA continued manned space flight under the Mercury and Gemini programs and preparations for Apollo. During a simulation flight at Launch Complex 34, three astronauts, Virgil Grissom, Edward White, and Roger Chaffee, lost their lives in an oxygen fire in the cockpit on January 27, 1967, an event later commemorated as Apollo 1. Apollo 4 (November 9, 1967) through Apollo 6 (April 4, 1968) were unmanned Earth orbital missions to test the Saturn rocket and the Command and Service modules. The October 11, 1968 Apollo 7 launch was the first manned Apollo launch which placed astronauts into Earth's orbit for a ten-day mission. Apollo 8, the first launch at the newly completed Kennedy Space Center, achieved the first lunar orbit in December 1968. The goal of landing man on the moon was achieved with Apollo 11 on July 20, 1969 and was followed by six additional lunar missions which gathered extensive scientific information culminating in Apollo 17 in December 1972. Subsequent manned space programs included the Skylab, Apollo-Soyuz, and the Space Shuttle, which took its inaugural flight on April 12, 1981. The Space Shuttle program ended on July 21, 2011.[28]

HISTORY OF COMPLEX 1/2

As one of the first launch complexes constructed at Cape Canaveral, Launch Complex 1/2 played a significant role in the future development of the Cape and the Cold War (Figure 1). The arms race between the United States and the Soviet Union to develop more powerful and accurate weapons was a defining feature of the Cold War. The missile research and development program,

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[26] Benson and Faherty, 65–68.

[27] Ibid., 96-98, 105, 133-137, 146-48.

[28] Barton and Levy, 31; Butowsky "Man in Space," 5-6.

in which Launch Complex 1/2 played a part, provided the United States with an operational, conventional, and nuclear missile force for defense in the arms race. Although technologically simple compared to subsequent facilities, Launch Complex 1/2 was at the forefront of scientific design at the time of its construction. As a military facility, the complex was periodically modified to support operational and programmatic changes.

As the construction agency for the Air Force at Cape Canaveral, the U.S. Army Corps of Engineers approved the contract for the construction of Launch Complex 1/2 on October 18, 1951 and initiated construction by October 26. Parsons Aerojet Company, an architectural and engineering firm of Los Angeles, California and Cocoa, Florida, prepared the plans. The property inventory card for the complex listed a value of $930,098 by 1960. Although the complex did not reach "beneficial occupancy" status until November 15, 1952, the first launch (from Pad 1) had occurred on August 29. The plans and completed construction were officially approved by the Corps in October and November 1953.[29]

This complex was constructed and used through the 1950s for the Snark missile program. Developed by Northrup for the Air Force in 1946, the Snark was a 15-ton surface-to-surface winged cruise missile which required a portable launcher platform. With a range of up to 6,325 miles, the Snark was the first and only long range intercontinental winged missile. The onboard Nortronics stellar inertial guidance system was the first of its kind and allowed the Snark to return and land at Cape Canaveral's skid strip. The Snark was one of the most popular missile programs in the Air Force with 97 missiles launched from Cape Canaveral (Figure 2 and Figure 3). The final Snark launch occurred on December 5, 1960 from Launch Pad 2. Snark missiles were withdrawn from service in 1961 after the development of the Atlas ICBM.[30]

During the 1950s, the complex was also used by the Matador combat training launch program. Developed by the Glenn L. Martin Company (later Martin Marietta), the Matador was also a surface-to-surface cruise missile which could carry a 3,000-pound conventional or nuclear warhead. The missile could be launched from a mobile ramp or hardened shelter and could travel 500 miles. The Air Force activated two "pilotless bomber" squadrons in 1951 and 1952 to launch these missiles. They were subsequently deployed in West Germany and Formosa. The first Mata-

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[29] Bramlitt, 1-2; Real Property Cards, Cape Canaveral Air Force Station; Eastern Test Range Launch Complexes, 1991; Parsons Aerojet Company, 1953; United States Air Force, Property Card 01-1541, Launch Complex 1/2 files.

[30] Clifford J. Lethbridge, "Snark Fact Sheet," Spaceline.org, Spaceline, Inc., 1998; Mark Cleary, Eastern Range Launches, (45th Space Wing Office of History, Patrick AFB, 11 December 2002); Mark C. Cleary, *The 6555th Missile and Space Launches Through 1970,* (45th Space Wing Office of History, Patrick AFB, 1991), 57–67.

dor was launched from Cape Canaveral on June 20, 1951. The Air Force launched approximately 286 Matador missiles from Launch Complexes 1/2 and 3/4 at Cape Canaveral before the missile was withdrawn from service in 1961.[31]

With the development of ICBMs and IRBMs, the Snark and Matador missiles were obsolete by the early 1960s. In conjunction with the deactivation of the Snark and Matador, Launch Complex 1/2 was deactivated for use as a missile launching site by 1962. Launch Complex 1/2 could not be reused as a launch complex due to the explosive hazards of the more powerful missiles and the proximity of the facilities at the complex. At this time, the Pre-launch Shelter was removed from the Complex. During the summer of 1962, the two Launch Pads, the Blockhouse, and the Preflight Building No. 1 were reassigned to the Mercury Rescue Unit as a helicopter landing area in support of the Mercury manned launches.[32] After the creation of NASA, the Air Force's manned space projects were transferred to the new organization and combined under the name Project Mercury in December 1958. The goals of Project Mercury included sending a man into space to orbit the Earth, testing his ability to perform in a weightless environment, and to recover both man and capsule.[33] The program included two manned suborbital flights and four manned orbital flights launched between 1961 and 1963.[34] At the conclusion of Mercury, the complex was briefly retired in 1964 and 1965. Between 1966 and 1983, the Blockhouse periodically served as office space resulting in the removal of instrumentation and control consoles and renovation of the interior.[35]

Launch Complex 1/2 was later transferred for use as part of the Tethered Aerostat Radar System from 1983 through 1989. The Tethered Aerostat Radar System provides low level radar surveillance data in support of the United States' drug interdiction program with a secondary mission of providing the North American Aerospace Defense Command with surveillance coverage to support air sovereignty in the Florida Straits.[36] The program started in Cudjoe Key, Florida, in December 1980. The aerostat site at Cape Canaveral was established in 1983, but was deactivated

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[31] Clifford J. Lethbridge, "Matador Fact Sheet,"; Clifford J. Lethbridge, "Cape Canaveral Rocket and Missile Box Scores,"; Cleary, "45th Space Wing: Its Heritage, History & Honors 1950-2001, Launch Facilities & Programs: Complexes 1 and 2"; Mark Cleary, Eastern Range Launches, 11 December 2002; Cleary, *6555th Missile and Space Launches,"* 20.

[32] United States Air Force, Voucher Nos. 63-1046 and 62-1505; Butowsky, National Register Nomination, 7:3.

[33] Spires, 39; *Exploring Space...Project Mercury*, 3.

[34] Barton and Levy, 28; Harry Butowsky, "Man in Space (Reconnaissance Survey) 1903-1981," 4.

[35] United States Air Force, Property Card 4140, Launch Complex 1/2 files.

[36] "Tethered Aerostat Radar System," Fact Sheet, (Langley Air Force Base: Air Combat Command, Public Affairs Office), 2003. www2.acc.af.mil/library/factsheets/tars.html.

by 1989. The Blockhouse served as the control center for the operation with the addition of a rear tower and an enlarged observation deck, while the Launch Pads served as tethered balloon facilities (Figure 4). At Cape Canaveral, the large helium-filled fabric balloon was capable of rising to a height of approximately 15,000’ while tethered by a cable with a maximum breaking strength of 26,000 pounds. The normal operating height was approximately 12,000'. Referred to as “Fat Albert,” the Cape Canaveral balloon was approximately 175' long x 58' across the hull. The aerostat lifted a payload of approximately 1,200 pounds to an operating altitude for low-level radar coverage. The radar data collected by the aerostat was transmitted to a blockhouse ground station below, where a flight controller monitored the balloon’s performance. The radar data was then digitized and provided to the various federal agencies for their use.[37] Facilities at the adjacent Launch Complex 3/4 were also utilized for the Tethered Aerostat Radar System (see HAER FL-8-9). Launch Complex 1/2 is now abandoned, and the machinery associated with the missile program has been removed, but the site remains largely intact.

Although not technically part of Launch Complex 1/2, Pad 24 (southwest of Pad 1) was constructed adjacent to Launch Complex 1/2 by 1956 (to the far right in Figure 4).[38] The plan for the site had two Launch Pads (23 and 24) and a Blockhouse, with the Launch Pads along the southeast side of Lighthouse Road (continuing the line of existing Launch Pads), and the Blockhouse across the road roughly in line with the Launch Complex 1/2 Blockhouse. The planned use for Launch Complex 23/24 was for the Navy Triton XSSM-2 surface-to-surface winged missile.[39] Only Launch Pad 24 was constructed, the Blockhouse was never built, and the Triton program never used Launch Pad 24. The Pad was subsequently used as part of the Snark program, serving as a hard surface for run-up tests of the Snark’s turbojet engine. The Snark was not launched from Pad 24.[40]

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[37] Cleary 2001; Butowsky, National Register Nomination, 113; United States Air Force, Property Card 4140, Launch Complex 1/2 files; United States Air Force, 2003; Hartmann, 2003; Roger McCormick, email photocopy, 2003.

[38] Thomas Penders, “8 BR 2253,” (Cape Canaveral Air Force Station: 45th Civil Engineer Squadron), undated.

[39] Air Force Space and Missile Museum, ”Complexes 23 and 24,” http://afspacemuseum.org/ccafs/CX23-24/, 2015.

[40] Ibid.

ARCHITECTURAL DESCRIPTION OF LAUNCH COMPLEX 1/2

Launch Complex 1/2 consists of two concrete Launch Pads serviced by one Blockhouse. The complex was originally located at the intersection of Central Control Road and Lighthouse Road; however, the road configuration later changed with the construction of Launch Complex 36. Lighthouse Road in this area was subsequently renamed Bumper Road. According to the 1958, 1959, and 1960 *Basic Information Guides* and the Real Property Inventory Card from the late 1950s, ancillary structures at Launch Complex 1/2 included the two Tunnel systems between the Launch Pads and the Blockhouse, a Preflight Building No. 1, a Pre-launch Shelter, a Septic Tank and Drain Field, a Transformer Building, Camera Pads for both Launch Pads, and electrical, water, and fire suppression systems.[41] Of these, the two Launch Pads (Facilities No. 4210 and No. 4141), the Blockhouse (Facility No. 4140), the Tunnels, the Transformer Building (Facility No. 4120), and vestiges of the electrical, water, and fire suppression systems remain, in a deteriorated condition.[42] Access to facility interiors was not possible due to safety concerns.

Launch Pads and Tunnels (Facilities No. 4210 and No. 4141)

Constructed between 1951 and 1953, both Launch Pad 1 (Facility No. 4210) and Launch Pad 2 (Facility No. 4141) were 200'-0" x 100'-0" which provided 2222.2 square yards of reinforced concrete poured 8" thick (Figure 5). Both Launch Pads were constructed at a cost of approximately $50,000 each. A drainage and trenching system provided for water and fuel runoff from the Launch Pads to a drain field. Camera stations were concrete pads adjacent to the Launch Pads which were wired for use by photographers.[43]

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[41] United States Air Force, "Real Property Accountable Record-Inventory Detail," Property Card 01-1541, Launch Complex 1/2 files; Pan American World Airways, Inc., *Basic Information Guide, 1958,* (Cape Canaveral Missile Test Annex, 1958), Research Planning/Design Engineering and Real Property Offices, Kennedy Space Center; Pan American World Airways, Inc., *Basic Information Guide, 1959,* (Cape Canaveral Missile Test Annex, 1959), Research Planning/Design Engineering and Real Property Offices, Kennedy Space Center; Pan American World Airways, Inc., *Basic Information Guide, 1960*, (Cape Canaveral Missile Test Annex, 1960), Research Planning/Design Engineering and Real Property Offices, Kennedy Space Center; "Eastern Test Range Launch Complexes, Cape Canaveral AFS," (45th Space Wing Office of History, Patrick AFB, 16 April 1991); Real Property Cards, Cape Canaveral Air Force Station.

[42] Master Planning, *CCAFS Basic Information Guide: Facilities at CCAFS and KSC*. KSC GP-14-2 (Kennedy Space Center: Space Gateway Support, October 2000).

[43] "Range Facilities at Station No. 1," MTTP, Long Range Proving Ground, 1951, (45th Space Wing History Office, Patrick AFB, scanned copy provided by Al Hartmann); United States Air Force, "Real Property Voucher," Voucher No. 54-79, Space Gateway Support Company, GIS Real Property Office, John F. Kennedy Space Center; United States Air Force, Property Cards 1533 and 1534, Launch Complex 1/2 files; Pan American World Airways, Inc., *Basic Information Guide, 1960;* Parsons Aerojet Company, *Air Force Missile Test Center: Launching Pads 1 and 2,* Drawings 01-01541-002, 01-01541-006, 01-01541-008, and 01-01541-014, 1953.

Tunnels, which originally were considered individual facilities separate from the Launch Pads, extended from under each Launch Pad to both sides (north and south facades) of the Blockhouse. Containing circuitry, potable water and fire lines, and carbon dioxide (CO_2) high-pressure air lines, the reinforced concrete tunnels protected these lines from destruction during a launch and allowed workers in the Blockhouse to remotely control launch operations. Each Tunnel was constructed at a cost of $95,500. The Tunnels under each Launch Pad were constructed of 1'-0" thick reinforced concrete walls with an inside diameter varying from 6'-0" wide x 7'-6" high to 4'-0" wide x 7'-6" high. One long tunnel extended north–south under each pad which was crossed by three transverse tunnels extending east-west. The northernmost transverse tunnel under Pad 1, and the southernmost transverse tunnel under Pad 2 continued west to the Blockhouse. The Tunnels were accessed through manhole hatches which were flush with the pad surface.[44]

Blockhouse (Facility No. 4140)

Constructed at a cost of $280,384, the reinforced concrete Blockhouse (Facility No. 4140) held the communications, instrumentation, and control consoles (Figure 6). The Blockhouse, located approximately 100’ from the Launch Pads, was partially inset in the ground on a concrete foundation. Operating as the launch control center, the Blockhouse had a vestibule area flanked by an equipment room, an air conditioning room, a restroom, and an electrical equipment room. An observation room with a semi-permanent partition separating the two launching areas held the control consoles utilized by personnel to remotely control a launch. Mirrored vision ports reflected a view of the launch pads during a launch. The two Tunnels, each with a fan room, extended to the Launch Pads from tunnel access rooms adjacent to the observation rooms. Most of the rooms retained their exposed concrete and concrete-block floor, ceiling, and walls and were finished with metal trim. The vestibule had a floor covered with asphalt tile, a plaster ceiling, and wood and metal trim. The observation room had asphalt tile floor, walls of smooth finish concrete, and an acoustic tile ceiling. A domed reinforced concrete roof, a concrete-block retaining wall on the east, and aluminum roll-up shutters to cover the windows protected the Blockhouse during a launch. An observation deck on top of the domed roof provided a view of the launch pads.[45] A 2,000 gallon septic tank (Facility No. 4143) served the Blockhouse.[46]

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[44] “Range Facilities at Station No. 1,” 1951; United States Air Force, Voucher No. 54-79; United States Air Force, Property Cards 01-1541, 1533T and 1534T, Launch Complex 1/ 2 files; E.R. Bramlitt, *History of Canaveral District 1950-1971*, 2, 14; Parsons Aerojet Company, *Launching Pads 1 and 2*.

[45] United States Air Force, Property Cards 01-1541 and 4140, Launch Complex 1/ 2 files; United States Air Force, Voucher No. 60-1182; Al Hartmann, Volunteer, Air Force Space and Missile Museum, Interview by author and e-mail, 30 April, 27 May, and 16 June 2003, CCAFS, notes from interview, Archaeological Consultants, Inc., Sarasota; Pan American

The Blockhouse initially had 2,074 square feet but was enlarged to 2,172 square feet of space with an addition in 1957. A small restroom addition of 98 square feet with concrete walls, a concrete slab foundation, and a flat built-up roof was made on the west side of the Blockhouse. In 1962, the complex was reassigned to serve the Mercury program. In 1964-65, the facility was briefly deactivated before being altered to serve as office space. During this period, the instrumentation and control consoles were removed and the interior of the Blockhouse was renovated. Carpet was installed over the original asphalt tile floor, a dropped ceiling was installed, and walls were surfaced with drywall and wood paneling. The rear tower was added, and the observation deck was enlarged when the Blockhouse was utilized for the Tethered Aerostat Radar System. From 1966 until around 1990, the Blockhouse endured periodic updates to the security, air conditioning, water, and fire suppression systems. The air-conditioning system was again improved in 1993. The building was abandoned during the mid-1990s.[47] For preservation purposes, a small refurbishment project was carried out on the Blockhouse in 2003–2004.[48] During this project, a broken window was replaced, and the mirrored vision ports were refurbished.[49]

Preflight Buildings No. 1 and No. 2 and Pre-launch Shelter (removed)

Typical of temporary structures utilized at Air Force bases throughout the post-World War II era, the Pre-launch Shelter at Launch Complex 1/2 was a temporary metal shelter on wheels covered by a canvas awning. The Pre-launch Shelter was identified on the 1958 *Basic Information Guide*. As a mobile facility, historic photographs show this structure adjacent to the Blockhouse as well as on the Launch Pads providing cover for a launch vehicle (Figure 7). The structure was not included in post-1960 *Basic Information Guides* or on the Real Property Inventory Card from the late 1950s, and may have been moved to another launch facility.[50]

World Airways, Inc., *Basic Information Guide*, 1960; Real Property Cards, Cape Canaveral Air Force Station; Bramlitt, 2, 14; Parsons Aerojet Company, *Launching Pads 1 and 2*.

[46] United States Air Force, Property Card 4143, Launch Complex 1/ 2 files.

[47] United States Air Force, Property Cards 01-1541 and 4140, Launch Complex 1/2 files; United States Air Force, Voucher No. 60-1182; Pan American World Airways, Inc., *Basic Information Guide*, 1960; Real Property Cards, Cape Canaveral Air Force Station; Bramlitt, 2, 14; Parsons Aerojet Company, *Launching Pads 1 and 2*; Hartmann 2003; United States Air Force, "Tethered Aerostat Radar System," Fact Sheet, (Langley Air Force Base: Air Combat Command, Public Affairs Office, 2003), www2.acc.af.mil/library/ factsheets/tars.html; Roger McCormick, volunteer, Air Force Space and Missile Museum, E-mail, 27 May 2003, CCAFS, E-mail photocopy, Archaeological Consultants, Inc., Sarasota.

[48] United States Air Force, Property Card 4140, Launch Complex 1/2 files.

[49] Technical Engineering and Spacelift Services, "CONS – Restore Complex 1,2,3,4 Facilities 4100 and 4140," Drawings (2003), U.S. Air Force, 45th Space Wing, Patrick AFB, Florida.

[50] United States Air Force, Property Card 01-1541, Launch Complex 1/ 2 files; Pan American World Airways, *Basic Information Guide*, 1958; Pan American World Airways, *Basic Information Guide*, 1959; Pan American World Airways, *Basic*

The Preflight Buildings No. 1 and No. 2 were semi-permanent buildings located immediately northwest of the Blockhouse. Included on the Real Property Inventory Card from the late 1950s, Preflight Building No. 1 was constructed in 1957. This metal structure served as a test shop for missile components (Figure 8). With 10,000 square feet of space, this structure was worth $215,480.

Similarly, Preflight Building No. 2 was a metal structure built in 1958 as a vehicle maintenance shop. By 1966, photographs show both the Preflight Buildings were in poor condition with portions of the roofs missing (Figure 9). In 1975, Preflight Buildings No. 1 and No. 2 were sold in place and removed.[51] Paved areas remain where Preflight Buildings No. 1 and No. 2 and the Prelaunch Shelter were once located.

Cable Terminal Building – East

Constructed in 1953 at a cost of $13,905, the cable building served as a relay facility for communications from the launch complexes.[52] Cables carried information from the launch complexes to the terminal building and onward to the main communications facilities at Cape Canaveral. There were several cable terminal buildings constructed at Cape Canaveral that handled communications cables for groups of launch complexes. As the launch complexes grew larger and more complicated, cable terminal buildings were often part of the facilities constructed for each complex.

The original structure was 27' by 27' (729 square feet) and constructed of reinforced concrete and concrete-block walls, with a concrete foundation and floor. The floor plan consisted of a control room with a small toilet room in the south corner. The cable vault ran underneath the northeast side of the control room in a basement and exited the building at the rear. The exterior had a re-

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Information Guide, 1960; Photograph 54-E-813, "GM-1111 Under Shelter, Pad No. 1," 45th Space Wing History Office, Patrick Air Force Base, scanned copy provided courtesy of Al Hartmann; Photograph 95032-105, University of Central Florida, Florida Space Coast History Project, scanned copy provided courtesy of Al Hartmann.

[51] United States Air Force, Property Cards 01-1541 and 1526, Launch Complex 1/ 2 files; United States Air Force, Voucher No. 62-1505; Pan American World Airways, *Basic Information Guide*, 1958; Pan American World Airways, *Basic Information Guide*, 1959; Pan American World Airways, *Basic Information Guide*, 1960; Pan American World Airways, *Basic Information Guide*, 1981 (Cape Canaveral Air Force Station, 1981), Research Planning/Design Engineering and Real Property Offices, Kennedy Space Center; Photograph 116-KSC-66-7161, 45th Space Wing History Office, Patrick Air Force Base, scanned copy provided courtesy of Al Hartmann; Photograph 106838-096, University of Central Florida, Florida Space Coast History Project, scanned copy provided courtesy of Al Hartmann.

[52] United States Air Force, "Real Property Accountable Record-Inventory Detail," Property Card 1532, Real Property Office, Cape Canaveral Air Force Station.

taining wall extending horizontally on each side of the front of the building (away from the launch complex) and an earth embankment wrapped around three sides of the building for blast protection. Roofing material was built–up tongue and groove. An addition was constructed in 1961 greatly increasing the size of the building to 2,781 square feet. The cost of the addition was $47,882. The addition was placed against the original front, extending to the northwest. A second set of retaining walls were added to the new building front, and additional earth filled in between the original retaining walls and the new retaining walls. The addition also had a basement below the expanded control room. No changes to the facility were recorded after a small modification in 1966 (air conditioning upgrade) until 2000, when the built-up roof was replaced with a metal one.[53]

Ground Support Equipment

Electrical, water, and fire suppression systems supported the activities at Launch Complex 1/2. The concrete-block Transformer Building (Facility No. 4120), which had 276 square feet of space, provided electrical power which was distributed throughout the complex by 7,482 feet of Electrical Distribution Lines. Constructed in 1953 at a cost of $5,000, the Transformer Building rested on a concrete slab foundation and was topped by a flat built-up roof.[54]

A Water Storage Reservoir, Firefighting Water Pump Station, and Water Storage Tank served the entire launching area and were located north of Launch Complex 1/2 and behind Launch Complex 3/4. The Potable Water Distribution System extended 1,410 feet throughout the complex which had a drainage system of 12,502 feet. The fire protection system was composed of 878 feet of Fire Protection Water Mains, 8,437 feet of wiring for a Fire Alarm System, Fire Alarm Boxes, and two Fire Hydrants.[55] The reservoir is mostly gone, and the remnant retains only a small amount of water. The Water Storage Tank was removed between 1971 and 1973, and the Firefighting Water Pump Station was removed between 1979 and 1981.[56]

A Sentry House was located southwest of Complex 1/2 near the intersection of Central Control Road and Bumper Road. This building was constructed of plywood, set on a wood foundation,

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[53] United States Air Force, “Real Property Accountable Record-Inventory Detail,” Property Card 1532.; United States Air Force, Real Property Accountable Record-Inventory Detail,” Facility 1532 property file.

[54] United States Air Force, Property Cards 01-1541 and 1541T, Launch Complex 1/2 files.

[55] United States Air Force, Property Cards 01-1541, Launch Complex 1/2 files; “Range Facilities at Station No. 1,” 1951.

[56] Pan American World Airways, *Basic Information Guides* for the years 1963–1981. Cape Canaveral.

and had a built-up roof. With a mere 36 square feet of space, the building was constructed in 1953 at a cost of $575, and was demolished in September 1973.[57]

Pad 24

The extant pad consists of a poured reinforced concrete slab measuring approximately 100 feet east to west and 50 feet north to south. The pad retains some metal tie downs and connection points. It is in fair condition.[58]

Conversion and Deactivation

Between 1952 and 1961, Launch Pads 1 and 2 were used to launch Snark and Matador missiles. By 1962, Launch Complex 1/2 was deactivated for use as a missile launching site. During the summer of 1962, the two Launch Pads, the Blockhouse, and the Preflight Building No. 1 were reassigned to the Mercury Rescue Unit as a helicopter landing area in support of the Mercury manned launches.[59] The Launch Pads and Blockhouse (along with some facilities at the adjacent Launch Complex 3/4) were later configured for use in the Tethered Aerostat Radar System between 1983 and 1989.[60] The complex was completely deactivated in the mid-1990s.[61] There was a small renovation/preservation project for the Blockhouse in 2003–2004, which was the last recorded alteration to the complex. Launch Complex 1/2 is now abandoned and is in a deteriorated state.

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[57] United States Air Force, Property Card 1546, Launch Complex 1/2 files.

[58] Thomas Penders, "8 BR 2253."

[59] United States Air Force, Voucher Nos. 63-1046 and 62-1505; Butowsky, National Register Nomination, 7:3.

[60] Mark Cleary, "45th Space Wing: Its Heritage, History & Honors 1950-2001, Launch Facilities & Programs: Complexes 1 and 2"; Butowsky, National Register Nomination, 113; Hartmann, 2003; United States Air Force, 2003; McCormick 2003.

[61] United States Air Force, Property Card 4140, Launch Complex 1/2 files.

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Photographs. 45th Space Wing History Office, Patrick Air Force Base. Scanned copy provided courtesy of Al Hartmann.

Photographs. University of Central Florida, Florida Space Coast History Project. Scanned copy provided courtesy of Al Hartmann.

"Range Facilities at Station No. 1." MTTP, Long Range Proving Ground, 1951. 45th Space Wing History Office, Patrick AFB. Scanned copy provided by Al Hartmann.

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HISTORIC DRAWINGS

As of 2016, the technical drawings used for research in this study have not been cleared for release to the public domain. It is, therefore, not possible to reproduce in this document the drawings used to gather information about the design, construction, and use of facilities at Launch Complex 1/2, CCAFS.

APPENDIX: FIGURES FROM DATA PAGES

Figure 1. Location of Launch Complex 1/2, CCAFS (Air Force Space and Missile Museum).

Figure 2. Launch Complex 1/2 looking south, with Snark missiles on Pads 1 and 2 and in a holding area south of Pad 1, August 1, 1957. U.S. Air Force Photograph 16356-5-C. Cape Canaveral Air Force Station Cultural Resources Office Archives.

Figure 3. Launching of Snark missile from Pad 2, March 3, 1960. U.S. Air Force Photograph, Air Force Space & Missile Museum.

Figure 4. Launch Complexes 1/2 (on right) and 3/4 (on left) showing the Tethered Balloon Facility (circular area), 1973. U.S. Air Force Photograph, U.S. Space & Missile Museum.

Figure 5. Launch Pads 1 and 2 in preparation for a Snark launch, April 26, 1954. Photograph 54-e-843, 45th Space Wing History Office, Patrick Air Force Base.

Figure 6. Complex 1/2 Blockhouse during construction, September 22, 1952. Photograph 52-g-1401, 45th Space Wing History Office, Patrick Air Force Base.

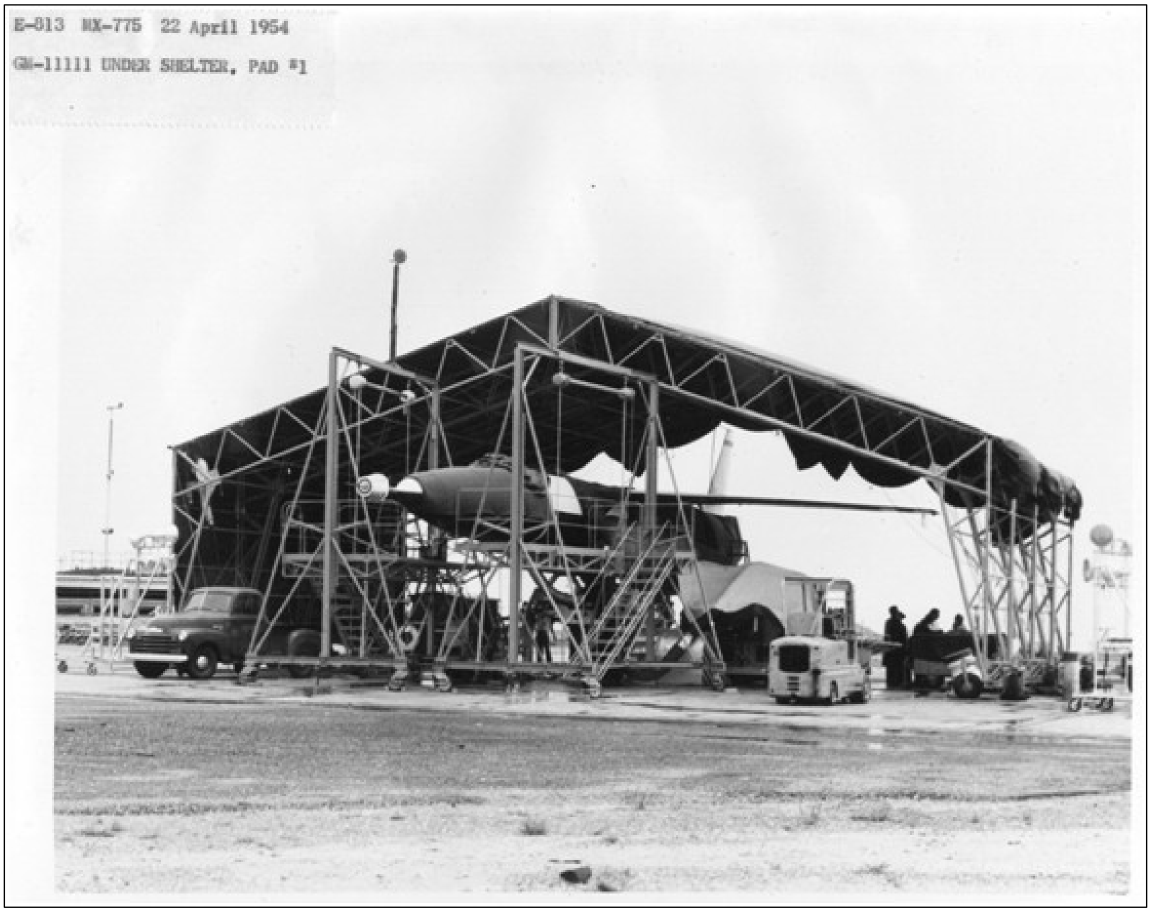

Figure 7. Pre-Launch Shelter covering Snark missile in preparation for a launch, April 22, 1954. Note Blockhouse in left background. Photograph 54-e-813, 45th Space Wing History Office, Patrick Air Force Base.

Figure 8. Snark missile in Preflight Building No. 1, April 2, 1958. Photograph 58-pl-58-40324, RCA Photo Lab, 45th Space Wing History Office, Patrick Air Force Base.

Figure 9. Launch Complex 1/2 with Pad 2 and Blockhouse in foreground and Preflight Buildings No. 1 and No. 2 and Launch Complex 36 in the background, 1966. Photograph 66-116-KSC-66-7161, NASA, 45th Space Wing History Office, Patrick Air Force Base.

CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 1/2 HAER No. FL-8-8

Northern terminus of Bumper Road (Lighthouse Road)
Cape Canaveral
Brevard County
Florida

PHOTOGRAPHS

HISTORIC AMERICAN ENGINEERING RECORD
Southeast Regional Office
National Park Service
U. S. Department of the Interior
100 Alabama Street, S.W.
Atlanta, GA 30303

HISTORIC AMERICAN ENGINEERING RECORD

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CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 1/2 — HAER No. FL-8-8

Northern terminus of Bumper Road (Lighthouse Road)
Cape Canaveral
Brevard County
Florida

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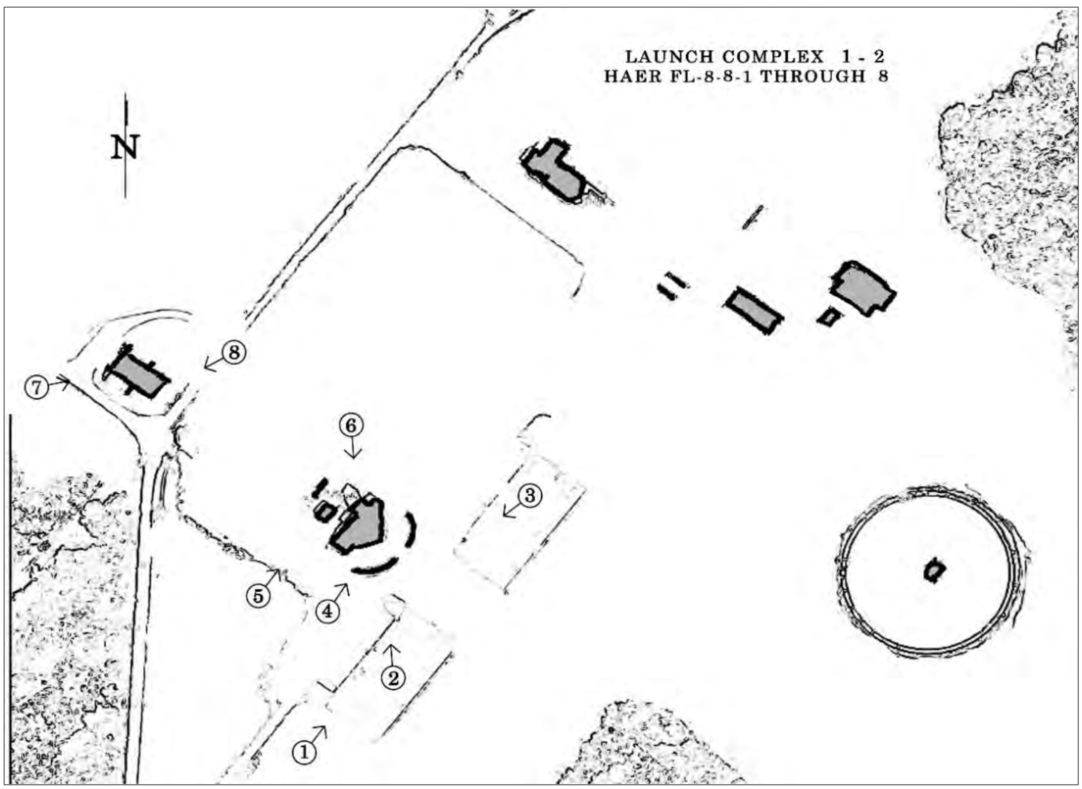
Photographer: Martin Stupich, 2014
See photo key on page 2 of Index to Photographs

FL-8-8-1	SLAB AS REMNANT OF LC 23/24 (foreground), SHOWING (L-R) LC-1/2 BLOCKHOUSE (No. 4140), SMALL ENGINE REPAIR BUILDING (No. 2805, LC 3/4), RADAR MAINTENANCE BUILDING (No. 2841, LC 3/4), GROUND SUPPORT BUILDING (No. 2826, LC 3/4); VIEW TO NORTH (on photo key as #1)



Photograph Key for Entire Complex.

HISTORIC AMERICAN ENGINEERING RECORD
CAPE CANAVERAL AIR FORCE STATION
LAUNCH COMPLEX 1 AND 2
SEE INDEX TO PHOTOGRAPHS FOR CAPTION
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CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 1/2, FACILITY No. 4210 — HAER No. FL-8-8-A
(LAUNCH COMPLEX 1/2, LAUNCH PAD 1)
Northern terminus of Bumper Road (Lighthouse Road)
Cape Canaveral
Brevard County
Florida

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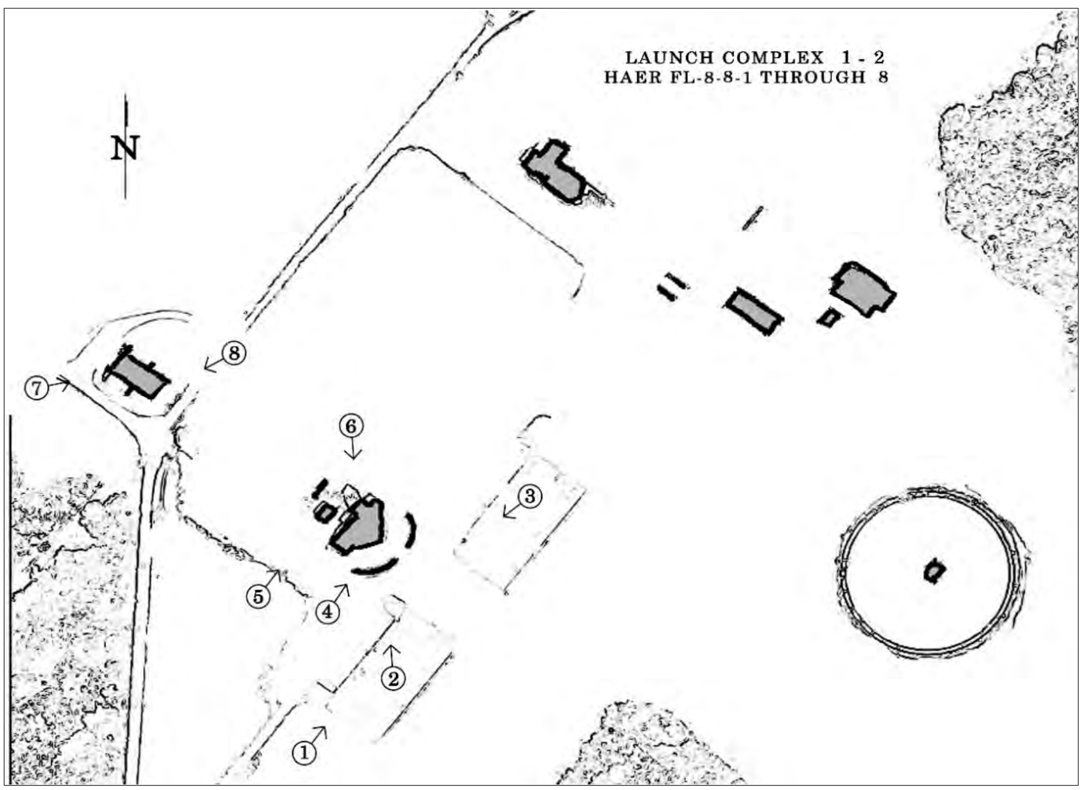
Photographer: Martin Stupich, 2014
See photo key on page 2 of Index to Photographs

FL-8-8-A-1	LAUNCH PAD 1, FACILITY NO. 4210, VIEW NORTH TO BLOCKHOUSE LC 1/2 (No. 4140) (on photo key as #2)



Photograph Key for Entire Complex.

HISTORIC AMERICAN ENGINEERING RECORD
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Northern terminus of Bumper Road (Lighthouse Road)
Cape Canaveral
Brevard County
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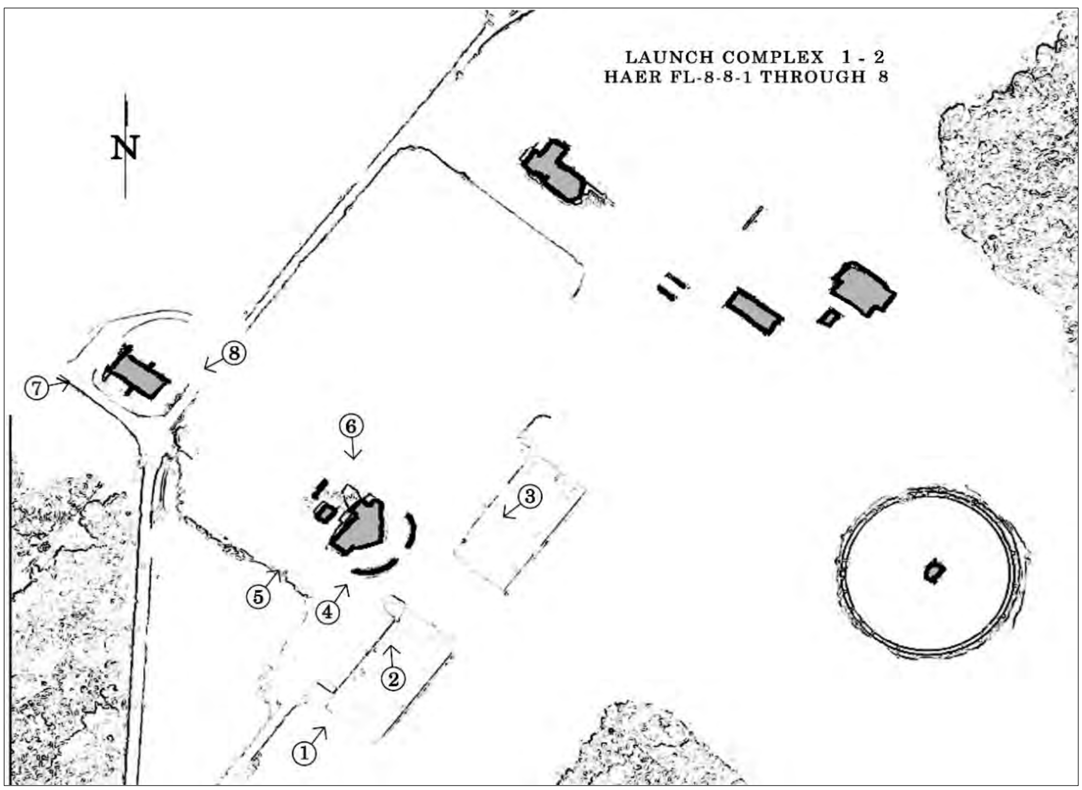
Photographer: Martin Stupich, 2014
See photo key on page 2 of Index to Photographs

FL-8-8-B-1	BLOCKHOUSE, VIEW TO SOUTH (on photo key as #3)
FL-8-8-B-2	BLOCKHOUSE, VIEW TO NORTH (on photo key as #4)
FL-8-8-B-3	BLOCKHOUSE WITH TRANSFORMER (No. 4120) TO FAR LEFT; VIEW TO NORTHEAST (on photo key as #5)
FL-8-8-B-4	BLOCKHOUSE, VIEW TO SOUTH, WITH TRANSFORMER BLDG. AND SHORT BLAST WALL (RIGHT); VIEW TO SOUTH (on photo key as #6)



Photograph Key for Entire Complex.

HISTORIC AMERICAN ENGINEERING RECORD
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CAPE CANAVERAL AIR FORCE STATION, HAER No. FL-8-8-C
LAUNCH COMPLEX 1/2, FACILITY No. 1532
(LAUNCH COMPLEX 1/2, EAST CABLE TERMINAL BUILDING)
Northern terminus of Bumper Road (Lighthouse Road)
Cape Canaveral
Brevard County
Florida

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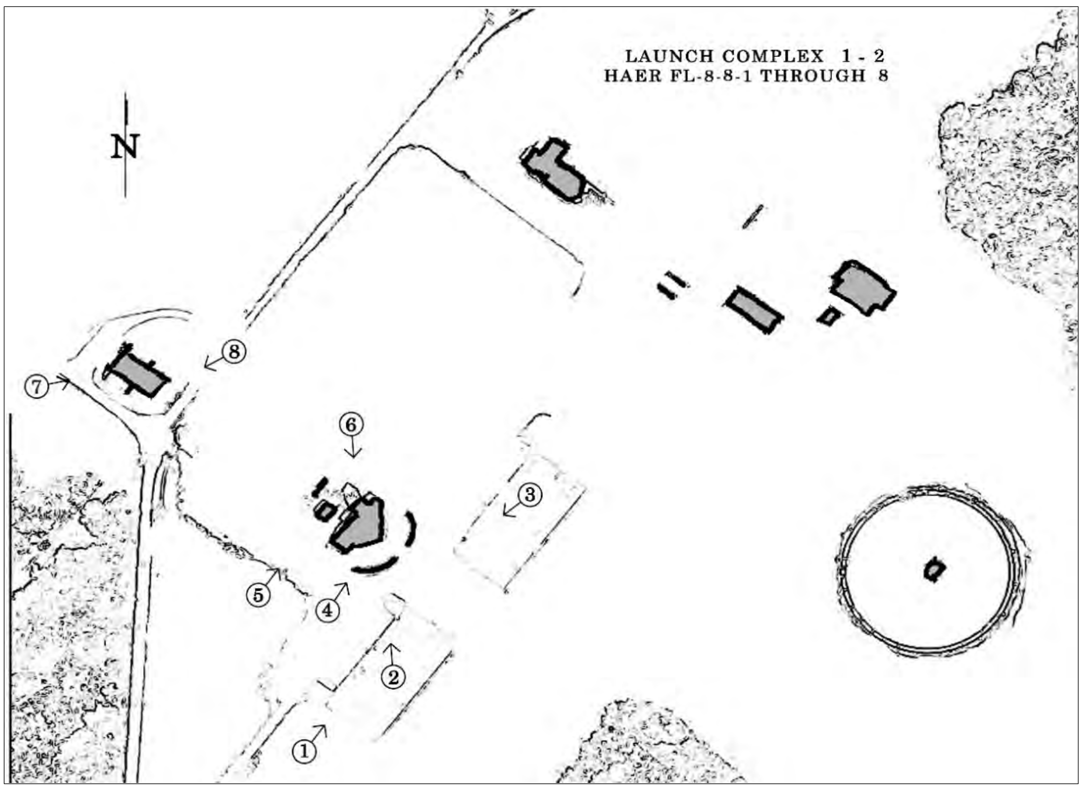
Photographer: Martin Stupich, 2014
See photo key on page 2 of Index to Photographs

FL-8-8-C-1	EAST CABLE TERMINAL BUILDING NW OF BLOCKHOUSE, VIEW TO EAST (NOTE BLOCKHOUSE IN BACKGROUND RIGHT) (on photo key as #7)
FL-8-8-C-2	EAST CABLE TERMINAL BUILDING, VIEW TO NORTH (on photo key as #8)



Photograph Key for Entire Complex.

HISTORIC AMERICAN ENGINEERING RECORD
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CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 3/4 HAER No. FL-8-9

Northern terminus of Bumper Road (Lighthouse Road)
Cape Canaveral
Brevard County
Florida

PHOTOGRAPHS
WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
Southeast Regional Office
National Park Service
U.S. Department of the Interior
100 Alabama Street, S.W.
Atlanta, GA 30303

HISTORIC AMERICAN ENGINEERING RECORD

CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 3/4

HAER No. FL-8-9

Location:	Northern terminus of Bumper Road (Lighthouse Road) 0.4 miles north of intersection with Central Control Road Cape Canaveral Brevard County Florida USGS Cape Canaveral Quadrangle, Universal Transverse Mercator Coordinates: 17.545362.3149024
Date of construction:	1950-1953
Engineer:	Sverdrup & Parcel, Inc.
Present owner:	United States Air Force
Present Use:	Vacant
Significance:	With over 125 missile launches between 1950 and 1960, Launch Complex 3/4 at Cape Canaveral Air Force Station played a vital role in the larger missile research and development program that provided the United States with an operational, conventional, and nuclear missile force for defense in the arms race. Launch Complex 3/4 was constructed and used throughout the 1950s for the Bumper, Matador, Bomarc, Lark, X-17, Polaris, and Redstone missile programs. Although simple compared to subsequent launch complexes, Launch Complex 3/4 was technologically advanced at the time of its construction. Facilities at Launch Complex 3/4 were subsequently modified to serve as a medical support area for the Mercury Project and, later, for use as the Tethered Aerostat Radar System.
Report prepared by:	Kimberly Hinder Architectural Historian, Archaeological Consultants, Inc. 8110 Blaikie Court, Suite A, Sarasota, Florida 34240 Updated - Dr. Susan Enscore U.S. Army Engineer Research and Development Center, Construction Engineering Research Laboratory 2902 Newmark Drive, Champaign, IL 61822
Date:	May 2003 (updated by Dr. Enscore February 2016)

HISTORICAL OVERVIEW OF CAPE CANAVERAL AIR FORCE STATION

Rocketry in the United States originated with the pioneering work of Robert H. Goddard, who launched the first liquid-propelled rocket in 1926. Across the Atlantic, German engineers were simultaneously developing their own rocket science program. Encouraged by the Nazi regime during World War II, the Germans developed the V-1 "buzz bomb" and the V-2 ballistic missiles which they used against Allied cities in 1944. Although the Allied forces had experimented with missiles powered by rocket engines, they lacked the technology to compete with the V-2 against which there was little defense. As a result, the U.S. Army, Navy, and Air Force each initiated their own missile programs to fulfill their particular roles in national defense.

Following the war, the U.S. Army brought 115 German rocket engineers and scientists, including Dr. Wernher von Braun, to the United States to develop their program. These engineers conducted experiments to refine the German V-2 and develop long-range surface-to-surface guided missiles. Initially stationed at Fort Bliss, Texas, the team assisted the Army in testing rockets at the White Sands Proving Grounds beginning in May 1946. This site, however, was geographically constrained and posed a danger to civilians when rockets misfired.[1]

Increasingly concerned with Soviet missile and nuclear development after World War II, the Department of Defense created and charged the Committee on Long Range Proving Grounds to select a suitable missile test site in October 1946. Cape Canaveral was selected for several critical reasons. Missiles could be launched over the Atlantic Ocean and tracked from islands. The isolated location of the Cape enhanced security for research and development. The government already owned land at the Cape, and the undeveloped nature of the remaining land made it less expensive to acquire. The launch area was accessible via water easing the transportation logistics of heavy rockets and building supplies. The warm weather also allowed year round operation of a missile site at the Cape.[2]

Until July 1947, the United States' military air forces were part of the Army (known as the Army Air Forces or AAF since 1941). The National Security Act of 1947 divided the military services into the three separate departments: the Army, the Navy, and the Air Force. In 1949, President

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[1] Charles D. Benson and William B. Faherty, *Moonport: A History of Apollo Launch Facilities and Operations* (National Aeronautics and Space Administration, Scientific and Technical Information Office, 1978; reprint as *Gateway to the Moon: Building the Kennedy Space Center Launch Complex* and *Moon Launch! A History of the Saturn-Apollo Launch Operations*, Gainesville: University Press of Florida, 2001), 1 (page references are to reprint edition).

[2] David Barton and Richard S. Levy, *An Architectural and Engineering Survey and Evaluation of Facilities at Cape Canaveral Air Force Station, Brevard County, Florida* (Resource Analysts, Inc., 16 March 1984), 3–4; Benson and Faherty, 4.

Harry S. Truman signed legislation which established the Joint Long Range Proving Ground at Cape Canaveral, with Patrick Air Force Base (originally the Banana River Naval Air Station) selected as the support base. Although the entire facility was initially under the cooperative use of the Army, Navy, and Air Force, the Air Force, by a directive of the Department of Defense, ultimately assumed responsibility for the range. The Joint Long Range Proving Ground was renamed the Air Force Missile Test Center, the first of many subsequent name changes. Although the Army continued its operation of the White Sands Proving Grounds in New Mexico and the Navy continued to fund its missile testing center at Point Mugu, California, both military branches continued to play an active role at Cape Canaveral.[3]

Construction and Missile Development at Cape Canaveral

Between April and June of 1950, land was acquired at the Cape through negotiation and condemnation proceedings. During this period, the United States Army Corps of Engineers was designated as the construction agency. The Jacksonville District of the Corps opened an office at Patrick Air Force Base in 1950 to oversee construction at Patrick Air Force Base and the Air Force Missile Test Center at Cape Canaveral. By December 1950, the office had managed $2.4 million of construction contracts. For each construction project, the agency (Army, Navy, Air Force) would submit project specifications, a deadline for completion, and authorization to begin construction to the Corps. The Corps would then negotiate and award a contract to an architectural/engineering firm for preparation of the construction plans. Once the plans were submitted, the Corps advertised and selected a contractor who was required to complete the project within the time frame or pay penalties.[4]

As the United States entered peacetime and reduced military funding during the late 1940s, the various branches of the military sought to determine their roles in missile research and design. The Army continued refining the German V-2, with the assistance of the team led by Wernher von Braun and 300 carloads of V-2 missile components seized during World War II. The Army conducted the first successful launch at Cape Canaveral on July 24, 1950. An Army-General Electric Corporation-California Institute of Technology team launched Bumper No. 8, a modified

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[3] E.R. Bramlitt, *History of Canaveral District 1950-1971*, (South Atlantic Division, U.S. Army Corps of Engineers, 1971), 1–2; Benson & Faherty, 3, 7.

[4] Bramlitt, 1–2, 33.

V-2 rocket, from Launch Pad 3. The Army team continued to use Pad 3 to conduct additional launches through 1951.[5]

During the late 1940s and early 1950s, Air Force activities at Cape Canaveral focused on winged cruise missile research and development as a deterrent force in the weapons race between the United States and the Soviet Union. Constrained by a reduced budget, the Air Force chose to fund research and testing on the cruise missile, projected to be operational before the ten years anticipated for the development of the ballistic missile. These winged missiles resembled unmanned airplanes and fell into four different categories: air-to-air, air-to-surface, surface-to-air, and surface-to-surface. These missiles were restricted to the Earth's atmosphere because they required oxygen for engine combustion. The earliest launch pads, used for firing experimental winged missiles including the Lark, Matador, Snark, Bomarc, Bull Goose, and Mace, were located at the tip of the Cape, and included Launch Complexes 1 & 2, 3 & 4, 9 & 10, and 21 & 22 (see Page 31). Support buildings, including a communications building, a water plant, a fire fighting unit, electrical substations, a skid strip for the landing and reuse of the missiles, and Hangars C and O, were constructed near the original launch pads. As explosive power increased, and missiles necessarily grew larger, support activities were relocated farther from the launch pads to an Industrial Area which was situated along the western shore of the Cape.[6]

After the Soviets detonated their first atomic device in 1949, and following the outbreak of war in Korea in 1950, the United States government reassessed the military cutbacks of the late 1940s. With increased funding and the development of relatively lightweight nuclear warheads, the Air Force and Army decided to pursue ballistic missile research and development. Faster and more accurate than the winged cruise missiles, ballistic missiles, with their own oxygen source, could leave the Earth's atmosphere. The ballistic missiles were divided into two categories based on the distance they could travel. The intercontinental ballistic missiles (ICBM) had a range of over 5,000 miles. Intermediate range ballistic missiles (IRBM) had a range of 1,500 miles. The Air Force, which remained focused primarily on the development of cruise missiles, initiated a ballistic missile study which resulted in the Atlas missile.[7]

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[5] Benson & Faherty, 1, 6–7.

[6] Barton and Levy, 6, 25; Bramlitt, 5-8; Jacob Neufeld, *The Development of Ballistic Missiles in the United States Air Force, 1945*-1960, (Washington, D.C.: Office of Air Force History, United States Air Force, 1990), 239.

[7] Neufeld, 98, 241; Benson and Faherty, 1, 3, 7.

To advance its research and development of ballistic missiles, the Army Ballistic Missile Agency moved their team of German engineers from Fort Bliss, Texas, to the Redstone Arsenal in Huntsville, Alabama. Soon after the move to Huntsville, the launch team, known as the Missile Firing Laboratory (MFL), established facilities at Cape Canaveral. With the first launch of the Redstone missile on August 20, 1953 at Launch Pad 4, the MFL inaugurated the testing of ballistic missiles, an event which foreshadowed the construction of numerous launch facilities for ballistic missiles at the Cape.[8]

Both the detonation of the first thermonuclear device in 1952 and intelligence reports indicating that the Soviet Union was developing long-range missiles and thermonuclear warheads led to advancements in ballistic missile development. In 1953, the Air Force formed a panel of U.S. scientists to examine their Snark, Navaho, and Atlas missile programs. The panel recommended accelerating development of the Atlas ICBM.[9] By 1955, Air Force officials convinced President Eisenhower to assign the ICBM development program the highest national priority. Accordingly, the Air Force initiated programs for the design and testing of the ICBM Titan in 1955 and the ICBM Minuteman in 1958. As the Air Force ICBM program grew, intelligence reports indicated that the Soviet Union would have ICBMs with nuclear warheads operational by 1960. Fearing that the United States could not match the Soviet ICBM threat, the Department of Defense decided to fund the development of IRBMs because they would be operational sooner and would act as a deterrent based out of Europe. In 1955, the Department of Defense approved two IRBM programs, the Air Force Thor and the Army/Navy Jupiter, which developed simultaneously and were assigned an equal national priority as the ICBM programs.[10]

The constant drive to develop more accurate and powerful weapons during the Cold War led to the construction of numerous launch complexes along the Cape. Although many of the early launch complexes were adapted to new uses as support structures, complexes constructed for one type of missile were rarely reused to launch another type of missile because they were not configured structurally, electronically, or for safety concerns for the new larger and more powerful missile. Economically, it was more cost effective to design and build a new complex than to reconfigure and adapt an old complex. Explosive hazards, the dangers of launching over other

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[8] Benson and Faherty, 1, 3, 7.

[9] Neufeld, 98-103; David N. Spires, "The Air Force and Military Space Missions: The Critical Years, 1957–1961," in *The U.S. Air Force in Space: 1945 to the 21st Century*, Proceedings Air Force Historical Foundation Symposium, Andrews AFB, Maryland, September 21-22, 1995, ed. R. Cargill Hall and Jacob Neufeld (Washington, DC: USAF History and Museums Program, United States Air Force, 1998), 34–35.

[10] Ibid., 143–148, 241–242.

complexes or inhabited areas, and maintaining a line of site between the launch vehicle and the launch control center (blockhouse) determined the choice of sites and distance between launch complexes. Each missile had similar ground requirements at the launch complex including a launch pad, a gantry service tower, a blockhouse for on-site command and control of the launch, and a network of power, fuel, and communication links.[11] The government maintained programs for both ICBMs and IRBMs concurrently and facilities for both types of missiles were constructed at Cape Canaveral. Over time, the area south of the tip was developed for launching IRBMs (Redstone, Pershing, Polaris/Poseidon, and Thor) and included launch complexes 5 & 6, 17, 18, 25, 26, 29, and 30). The area north of the tip was developed for launching ICBMs and space launch vehicles (Atlas, Titan, Saturn) and included complexes 11, 12, 13, 14, 15, 16, 19, 20, 34, 36, and 37.[12]

Throughout the early and mid-1950s, the focus of activities at Cape Canaveral remained on missile development for defense against the Soviets. In November 1956, the Secretary of Defense divided the responsibilities for research and development of missiles among the armed forces. The Air Force received responsibility for all intermediate and long-range missiles, both IRBMs and ICBMs, while the Army was restricted to missiles with a range of 200 miles or less. The Navy was limited to developing submarine and ship-based IRBM missile systems.[13]

Cape Canaveral and the United States Space Program

In 1955, President Eisenhower announced that the United States would launch an unmanned satellite as part of the nation's participation in the International Geophysical Year which extended from July 1957 through December 1958. The Army, Navy, and Air Force immediately initiated planning for their own satellite programs.[14] When the Soviets launched the satellite Sputnik I in October of 1957, the attention of the public turned to space exploration. The following month, the Soviets placed the Sputnik II satellite carrying a dog into orbit around the Earth. The launch

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[11] Benson and Faherty, 8-10.

[12] Barton and Levy, 4, 9; Denise P. Messick, Cynthia G. Rhodes, and Charles E. Cantley, *45th Space Wing Cultural Resource Management Plan*, Technical Report No. 386 (Stone Mountain, Georgia: New South Associates, 1996), 95; James N. Gibson, *Nuclear Weapons of the United States: An Illustrated History* (Atglen, PA: Schiffer Publishing, Ltd., 2000); Hartmann 2003.

[13] Neufeld, 242; Barton and Levy, 17.

[14] R. Cargill Hall, "Civil-Military Relations in America's Early Space Program," in *The U.S. Air Force in Space: 1945 to the 21st Century*, Proceedings Air Force Historical Foundation Symposium, Andrews AFB, Maryland, September 21–22, 1995, ed. R. Cargill Hall and Jacob Neufeld (Washington, DC: USAF History and Museums Program, United States Air Force, 1998), 25.

caused a furor among Americans who feared that the U.S. was losing not only the “space race,” but also that a “missile gap” existed between the U.S. and the Soviets, who it was believed had hundreds of operational ICBMs. The President initially assigned responsibility for the U.S. space program to the Department of Defense. The Army’s Development Operations Division led by Wernher von Braun shifted their focus to the use of missiles to propel payloads, or even a man, into space.[15] After several failures on the launch pad, the United States entered the space race with the launch of the Army’s scientific satellite Explorer I on January 31, 1958 using a four stage Jupiter C missile named Juno I. With the threat of a growing fleet of operational Soviet ICBMs, the branches of the U.S. military initiated the development of photographic reconnaissance satellites which were operational by 1960.[16]

Realizing that the military’s involvement in the space program would jeopardize the goal of using space for peaceful purposes, the President’s Science Advisory Committee urged that a centralized agency be created to oversee the scientific exploration of space. The new agency, the National Aeronautics and Space Administration (NASA), established October 1, 1958, was to be a civilian agency with the mission of carrying out scientific aeronautical and space exploration, both manned and unmanned. The Department of Defense, especially the Air Force, would continue with defense related missile and satellite development.[17] Soon after the creation of NASA, Navy personnel and facilities associated with Project Vanguard and over 400 scientists from the Naval Research Laboratory were reassigned to NASA. The California Institute of Technology’s Jet Propulsion Laboratory, affiliated with the Army, was also transferred to NASA. Initially working with NASA as part of a cooperative agreement, President Eisenhower officially transferred a large portion of the Army’s Development Operations Division with the team led by Wernher von Braun to NASA in March 1960. At the same time, Eisenhower named the Huntsville NASA installation the Marshall Space Flight Center, and designated the MFL at Cape Canaveral as the Launch Operations Directorate of NASA. The Launch Operations Directorate, led by Dr. Kurt Debus, managed the overall integration, testing, and the launch operations of NASA.[18]

NASA soon organized a National Launch Vehicle Program to identify and analyze which missiles would be the most effective in exploring space. As a result, the Scout, Thor (Delta), Atlas,

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[15] Benson and Faherty, 1-2.

[16] Ibid.

[17] Hall, 30; Barton and Levy, 20; Spires, 39.

[18] Spires, 39; Benson and Faherty, 15.

Titan, and Saturn, and modified versions of these rockets, were selected as boosters for manned and unmanned missions. Unmanned activities have included suborbital, orbital, and lunar satellite and vehicular missions to gather scientific information often relating to physics and astronomy. Although some were conducted to prepare for manned launches, most of the missions were intended simply to gain scientific knowledge with which to better understand Earth.[19]

Already upstaged by the Soviets, one of NASA's first goals was to put a man in orbit around the Earth. At its creation, the Air Force's manned space projects were transferred to NASA, which NASA combined under the name Project Mercury in December 1958. NASA selected the first seven astronauts for the manned space program in April 1959. The goals of Project Mercury included sending a man into space to orbit the Earth, testing his ability to perform in a weightless environment, and to recover both man and capsule.[20] The program included two manned suborbital flights powered by a modified Redstone missile and four manned orbital flights powered by an Atlas missile topped by the Mercury capsule. The first suborbital flight occurred on January 31, 1961 with the launch of Ham, a chimpanzee. The United States was again upstaged when the Soviet Union launched Vostock I with cosmonaut Uri Gagarin to orbit the Earth in April 1961. The launch of Alan Shepard the following month on a Mercury suborbital flight proved anticlimactic.[21]

Realizing the impact of the Soviet advancements on the American psyche, President John F. Kennedy appointed Vice President Lyndon Johnson, in cooperation with representatives from NASA and the associated industries, to develop a space program that would surpass the Soviet program. The panel recommended a ten-year phased approach which would include manned space flight, planetary exploration, and the development of new rockets and satellites. Accepting the recommendations, President Kennedy presented the following before a joint session of Congress on May 25, 1961:

> I believe this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the Moon and returning him safely to the Earth. No single space project in this period will be more impressive to mankind, or more

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[19] Barton and Levy, 20–27.

[20] Spires, 39; *Exploring Space...Project Mercury* (U.S. National Aeronautics and Space Administration) 3, Kennedy Space Center Archives, Kennedy Space Center, Sweetsir Collection 95-15, Box 12.

[21] Harry Butowsky, "Man in Space (Reconnaissance Survey) 1903–1981," (Denver: National Park Service, 1981), 4.

> important for the long-range exploration of space, and none will be so difficult or expensive to accomplish.[22]

With widespread support, the public and Congress embraced the goal and the program proceeded rapidly. Circling the Earth three times, John Glenn completed the first manned orbital flight of the United States on February 20, 1962 in a capsule propelled by an Atlas rocket from Launch Complex 14. Followed by three more manned orbital flights, the Mercury program concluded as a success on May 15, 1963.[23]

NASA initiated planning for Project Gemini in late 1961 as the intermediate step in sending a man to the moon. Officially announced in 1962, the project was operational by 1964. The goals of Project Gemini included testing man’s performance during extended periods in space, both within and outside of the spacecraft, development of rendezvous and docking techniques, and perfection of controlled reentry and landing techniques. The larger, more maneuverable capsule, designed to hold two men, was propelled by a Titan II rocket. Following the first unmanned Gemini launch on April 8, 1964, Gemini 3 was the first manned flight of the program in March 1965. Gemini 12, launched in November 1966, successfully completed the program.

Apollo, the final step in landing astronauts on the moon, immediately followed Project Gemini. Studies to build the Saturn rocket, which would propel man to the moon, actually started in 1957 with the team led by Wernher von Braun under the Army’s jurisdiction.[24] Ten times more powerful than the Atlas rocket and twenty times more powerful than the Jupiter, the size and power of the Saturn required the construction of Launch Complexes 34 and 37 at Cape Canaveral. Test flights of the Saturn rocket started at Launch Complex 34 in October 1961. In January 1962, NASA announced that the Saturn would be the moon launch vehicle. The goal of Apollo was to launch a team of three astronauts into orbit around the moon. While one astronaut remained in orbit, the other two would then take an attached spacecraft to land on the moon and then redock with the primary vessel before returning to Earth. The initial missions were Earth orbital (unmanned and manned) followed by lunar missions to orbit and, later, land on the moon.[25]

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[22] Butowsky “Man in Space,” 4–5.

[23] Barton and Levy, 28.

[24] Benson and Faherty, 1–2.

[25] ibid., 37, 60–64; Barton and Levy, 30–31.

NASA utilized Launch Complexes 34 and 37 for research and development of the Saturn rocket. Continued modifications to the Saturn to increase its power to propel man to the moon led to a larger rocket with new blast and acoustic hazards. With these factors in mind, combined with the stepped-up launch schedule necessary to land a man on the moon by the end of the decade, it was apparent by 1961 that the Apollo program required a new launch complex.[26] Cape Canaveral, with over 22 launch complexes, did not have room for another complex. NASA officials solved the dilemma by acquiring land on Merritt Island, west and north of the existing missile launching area at the Cape. The first acquisitions of land started in 1962, with the majority under federal ownership by 1964. Initially known as the Merritt Island Launch Area, the land was acquired for use predominantly in support of the Manned Lunar Landing Program (Apollo) and was placed under NASA's exclusive jurisdiction. With the new facilities, NASA's offices at the Cape, led by Kurt Debus, expanded and relocated to the Merritt Island Launch Area. The newly independent installation, on par with Marshall Space Flight Center, was renamed the John F. Kennedy Space Center in November 1963 after the death of the president.[27]

During land acquisition and construction of the Kennedy Space Center, NASA continued manned space flight under the Mercury and Gemini programs and preparations for Apollo. During a simulation flight at Launch Complex 34, three astronauts, Virgil Grissom, Edward White, and Roger Chaffee, lost their lives in an oxygen fire in the cockpit on January 27, 1967, an event later commemorated as Apollo 1. Apollo 4 (November 9, 1967) through Apollo 6 (April 4, 1968) were unmanned Earth orbital missions to test the Saturn rocket and the Command and Service modules. The October 11, 1968 Apollo 7 launch was the first manned Apollo launch which placed astronauts into Earth's orbit for a ten-day mission. Apollo 8, the first launch at the newly completed Kennedy Space Center, achieved the first lunar orbit in December 1968. The goal of landing man on the moon was achieved with Apollo 11 on July 20, 1969 and was followed by six additional lunar missions which gathered extensive scientific information culminating in Apollo 17 in December 1972. Subsequent manned space programs included the Skylab, Apollo-Soyuz, and the Space Shuttle, which took its inaugural flight on April 12, 1981. The Space Shuttle program ended on July 21, 2011.[28]

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[26] Benson and Faherty, 65–68.

[27] Ibid., 96-98, 105, 133–137, 146–148.

[28] Barton and Levy, 31; Butowsky "Man in Space," 5–6.

History of Complex 3/4

As the first launch complex constructed at Cape Canaveral, Launch Complex 3/4 played a significant role in the future development of the Cape and the Cold War (Figure 1). The arms race between the United States and the Soviet Union to develop more powerful and accurate weapons was a defining feature of the Cold War. The missile research and development program, in which Launch Complex 3/4 played a vital part, provided the United States with an operational, conventional, and nuclear missile force for defense in the arms race. Although technologically simple compared to subsequent facilities, Launch Complex 3/4 was at the forefront of scientific design at the time of its construction. As a military facility, the complex was periodically modified to support operational and programmatic changes.

As the construction agency for the Air Force at Cape Canaveral, the U.S. Army Corps of Engineers selected the contractor, approved the contract, and initiated construction of Launch Pad 3 on May 9, 1950. Although Launch Pad 3 was not officially accepted until November 19, 1951, the first launch from the pad, which marked the initial launch from Cape Canaveral, occurred on July 24, 1950. Launch Pad 3 was utilized for the Bumper, Matador, Bomarc, Lark, X-17, and Polaris FTV missile programs. Construction on Launch Pad 4 started on September 5, 1951, with the first launch occurring on September 10, 1952. Built for the Bomarc missile program, Launch Pad 4 was also used for the Redstone missile program. Sverdrup & Parcel, Inc., consulting engineers of St. Louis, Missouri, prepared the plans. The plans and completed construction were officially approved by the Corps in March 1953.[29]

The final two launches in the Bumper program were the first two launches at Cape Canaveral. The Bumper-WAC missile consisted of a modified German V-2 missile combined with a U.S. Army Without Any Control (WAC)-Corporal research rocket. A cooperative effort between Douglas Aircraft (later McDonnell Douglas), the Guggenheim Aeronautical Laboratory, and the Jet Propulsion Laboratory at the California Institute of Technology resulted in the design of the WAC-Corporal. The WAC-Corporal and V-2 were combined to study technical problems associated with rocket stage separation, high altitude flight dynamics, and high altitude rocket stage ignition. Starting in May 1948, the first six Bumper-WAC rockets were launched from the White Sands Missile Range in New Mexico. In 1950, the Army moved its program to the new missile

[29] Bramlitt, 1–2; Real Property Cards, Cape Canaveral Air Force Station; "Eastern Test Range Launch Complexes, 1991"; Sverdrup & Parcel, Inc., *Joint Long Range Proving Ground,* Drawings 01-01540-003, 01-01540-004, 01-01540-005, and 01-01540-006, Research Planning/Design Engineering Office, Kennedy Space Center, 1953; Mark Cleary, "Eastern Range Launches," 11 December 2002.

range at Cape Canaveral. Launch Pad 3 was the first site chosen to be constructed because it was drier than the relatively marshy areas designated for Pads 1, 2, and 4, and, therefore, easier and quicker to construct.[30]

Workers initiated construction by digging a large eight-foot-deep hole and a series of underground access tunnels at the site of the launch pad. A compartmentalized cement box with equipment rooms would fill the hole. Once constructed, the area around it was backfilled with sand and a reinforced concrete launch pad 98'-0" x 96'-6" was then poured over the structure. The electrical generators, circuitry, and high pressure air in the underground tunnels and rooms were accessible via stainless steel hatches built flush into the surface of the launch pad. The water deluge system consisted of curbed areas bordering the launch pad which funneled runoff to a catch basin. A small, wood frame building was constructed approximately 400' north of the launch pad to serve as a firing room (Figure 2). Built on a 20'-0" by 20'-0" concrete slab, the building was constructed of wood surfaced with a “grayish silver felt material” to reflect the sun. Surrounded by a sand embankment, this first blockhouse had a window with reflective mirrors which allowed occupants to view the launch while remaining lower than ground level. This building was removed the following year after the construction of the permanent blockhouse immediately southwest.[31] The location of the original blockhouse is currently unknown, although it is likely to have been located in the undeveloped area to the northeast of the existing Launch Complex 3/4 Blockhouse.

The Bumper rockets were erected on top of a steel firing table set on the launch pad. The Army constructed the first mobile service structure out of scaffolding purchased in Orlando. Built on wheels, the structure was manually moved around the rocket (Figure 3). A pine telephone pole served as the first umbilical tower, while Army mattresses were used to catch the umbilical connections as they fell away from the rocket during launch. Navy ships provided offshore tracking. The first planned launch of Bumper 7 on July 19, 1950 misfired and was rescheduled to follow Bumper 8 due to problems with the rocket. On July 24, 1950, an Army-General Electric Corporation-California Institute of Technology team launched Bumper 8, the first launch from Pad 3 and Cape Canaveral (Figure 4). The rescheduled launch of Bumper 7, the final Bumper launch, followed five days later.[32]

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[30] Clifford J. Lethbridge, “Bumper-WAC Fact Sheet,” Spaceline.org, Spaceline, Inc., 2000; Cleary, “Eastern Range Launches”; Lethbridge, “Launch Pad 3”; Bramlitt, 1-2.

[31] Lethbridge, “Launch Pad 3”; Bramlitt, 1–2; Hartmann 2003.

[32] Ibid.; Lethbridge, “Bumper-WAC Fact Sheet”; Cleary, “Eastern Range Launches.”

During the 1950s, the complex was also used by the Matador combat training launch program. Developed by the Glenn L. Martin Company (later Martin Marietta), the Matador was also a surface-to-surface cruise missile which could carry a 3,000-pound conventional or nuclear warhead. The missile could be launched from a mobile ramp or hardened shelter and could travel 500 miles (Figure 5). The Air Force activated two “pilotless bomber” squadrons in 1951 and 1952 to launch these missiles. The first Matador was launched from Cape Canaveral on June 20, 1951. They were subsequently deployed in West Germany and Formosa. The Air Force launched approximately 286 Matador missiles from Launch Complexes 1-4 at Cape Canaveral before the missile was withdrawn from service in 1961.[33]

The Bomarc was a surface-to-air missile created for the Air Force in a cooperative effort between Boeing and the University of Michigan Aeronautical Research Center. With a basic airplane configuration, the Bomarc was capable of vertical take-off and a cruising speed of four times the speed of sound. The missile could be launched from either a launcher stand or a fixed shelter (Figure 6). The Bomarc Launching Building (Facility No. 2841), also referred to as Pad 4A, was designed with a roof which would split in the center while the Bomarc missile was raised for a quick launch (Figure 7). Due to the expense of maintenance and construction of the building, later shelters had a sliding roof. Fitted with a conventional or nuclear payload, the Bomarc was the first weapons system to incorporate an active homing system. Early Bomarc missiles had a range of 230 miles, while later improvements increased the range to 440 miles.

The Bomarc prototype was first test-flown on September 10, 1952, the first launch from Launch Pad 4. At least 17 additional Bomarc missiles were launched from Pad 4 and the Bomarc Launching Building between February 1955 and April 1960. Between August 1954 and May 1955, the Air Force launched seven Bomarc flights from Launch Pad 3. The Bomarc missile remained in use until 1972.[34]

The first Redstone missile was test launched from Pad 4 on August 20, 1953. The Redstone was one of the first operational U.S. ballistic missiles. Developed by the team led by Wernher von Braun for the Army Ballistic Missile Agency, the Redstone was a field mobile missile capable of

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[33] Clifford J. Lethbridge, “Matador Fact Sheet,” Spaceline.org, Spaceline, Inc., 1998; Clifford J. Lethbridge, “Cape Canaveral Rocket and Missile Box Scores,” Spaceline.org, Spaceline, Inc., 2001; Cleary, “Complexes 3 and 4”; Cleary, Eastern Range Launches; Mark C. Cleary, *The 6555th Missile and Space Launches Through 1970,* (45th Space Wing Office of History, Patrick AFB, 1991), 20, 27.

[34] Lethbridge, “Bomarc A Fact Sheet,” 1998; Clifford J. Lethbridge, “Bomarc B Fact Sheet,” Spaceline.org, Spaceline, Inc., 1998; Cleary, Eastern Range Launches; Lethbridge, “Cape Canaveral Rocket and Missile Box Scores”; Lethbridge, “Cape Canaveral Launch Sites Box Scores”; Cleary, “*6555th Missile and Space Launches,”* 52–56.

being launched by combat troops from a circular stand. While awaiting the construction of Launch Complex 5 and 6, the Army utilized Pad 4 to launch five additional Redstone missiles between August 1953 and February 1955 (Figure 8). Redstone technology was used to launch the first U.S. satellite in January 1958, was utilized in the suborbital missions of Project Mercury, and was adapted to create the Saturn family of rockets used to send man to the moon.[35]

The X-17 research rocket was developed for the Air Force by Lockheed in January 1955. At the onset of development of the ICBM missile, the Air Force realized that no information existed on how missile nose cones would react during high-speed re-entry through the Earth's atmosphere. The X-17 was developed to gather data to determine the best shape, size, and aerodynamic characteristics of nose cones. The first test version of the X-17 was launched from Pad 3 on May 23, 1955. The rockets flew with nose cones of different shapes, and, upon re-entry, sensors in the nose cones transmitted data concerning temperature, pressure, and flight dynamics. The Air Force conducted 25 operational research flights of the X-17 (Figure 9). All of the flights, the last of which was conducted on July 22, 1957, were launched from Pad 3. The X-17 was critical in determining that a blunt nose cone was the best shape for use on the Atlas and Titan ICBMs.[36]

In the mid-to-late-1950s, Lockheed decided to utilize the existing solid-fueled X-17 rocket to test innovations planned for the creation of a new, solid-fueled Fleet Ballistic Missile (FBM), also known as submarine-launched ballistic missiles. The X-17 rocket was used to test new guidance mechanisms, nose cone technology, and overall flight dynamics. The X-17 rockets were extremely useful because problems could be fixed prior to the production of the actual missile prototypes. After the new missile was created and named the Polaris, the X-17 rockets used during test flights became known as the Polaris Flight Test Vehicle (FTV). The first Polaris FTV was launched from Pad 3 on April 13, 1957. By January 1958, 12 additional Polaris FTVs were launched from Pad 3.[37]

Launch Complex 3/4 was also used to test the Lark program. Approximately 40 Lark winged missiles were launched between October 25, 1950 and July 8, 1953. Many of these utilized Pad 3. The Lark was a surface-to-air Navy rocket developed by the Consolidated Vultee Aircraft Corporation (Convair). The Lark was utilized as a training foundation for the Bomarc program.

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[35] Clifford J. Lethbridge, "Redstone Fact Sheet," Spaceline.org, Spaceline, Inc., 2000; Cleary, Eastern Range Launches.

[36] Clifford J. Lethbridge, "X-17 Fact Sheet," Spaceline.org, Spaceline, Inc., 1998; Cleary, Eastern Range Launches.

[37] Clifford J. Lethbridge, "Polaris FTV," Spaceline.org, Spaceline, Inc., 1998; Clifford J. Lethbridge, "Polaris A1," Spaceline.org, Spaceline, Inc., 1998; Cleary, Eastern Range Launches.

As many of these were conducted prior to the construction of the permanent blockhouse, a tank was used as a firing room for the Lark missile launches (Figure 10). Over 125 launches occurred at Launch Complex 3/4 during its operational years between 1950 and 1960.[38]

By the early 1960s, the missiles tested at Launch Complex 3/4 were either declared operational or made obsolete by advancements in the development of IRBMs and ICBMs. Launch Complex 3/4 was deactivated for use as a missile launching site by 1961. The complex could not be reused for launching missiles due to the explosive hazards of the more powerful missiles and the proximity of the facilities at the complex. In 1961 and 1962, the two Launch Pads (Facilities No. 4101 and No. 2840) and the Blockhouse (Facility No. 4100) were reassigned to the Mercury Rescue Unit in support of the Mercury manned launches. After the creation of NASA, the Air Force's manned space projects were transferred to the new organization and combined under the name Project Mercury in December 1958. The goals of Project Mercury included sending a man into space to orbit the Earth, testing his ability to perform in a weightless environment, and to recover both man and capsule. The program included two manned suborbital flights and four manned orbital flights launched between 1961 and 1963. From 1961 to around 1967, the two Launch Pads served as a helicopter landing area. The Blockhouse was converted to a Dispensary/Forward Medical Station for the program which resulted in the removal of instrumentation and control consoles. In 1963, the Launch Support Building was relocated to the Industrial Area at Cape Canaveral.[39]

Following the 1960 deployment of an operational Bomarc missile to bases throughout the United States, the Bomarc Launching Building (Facility No. 2841) was reassigned and altered to serve as the Delta Spin Balance Facility for NASA's Delta program which was introduced in 1959. Based on the Thor IRBM, Douglas Aircraft designed the Delta (originally called the Thor-Delta) vehicle specifically for civilian and commercial satellite payloads launched by NASA. The Delta was a three-stage launch vehicle composed of a Thor IRBM mated to improved Vanguard rocket upper stages. NASA utilized the former Bomarc Launching Building to conduct spin tests on the

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[38] Neufeld, 45; Bramlitt, 11; Lethbridge, "Cape Canaveral Rocket and Missile Box Scores"; Lethbridge, "Launch Pad 3"; Cleary, "6555th Missile and Space Launches," 51-52.

[39] United States Air Force, "Real Property Voucher," Voucher No. 63-1046, Space Gateway Support Company, GIS Real Property Office, John F. Kennedy Space Center; United States Air Force, "Real Property Accountable Record-Inventory Detail," Property Cards 1535, 4101, 1536, 2840, 4100, and 01-1540, Launch Complex 3/4 files, Space Gateway Support Company, GIS Real Property Office, John F. Kennedy Space Center; Butowsky, National Register Nomination, 7:3; Spires, 39; Exploring Space...Project Mercury, 3; Barton and Levy, 28; Butowsky, "Man in Space," 4; Pan American World Airways, Inc., Basic Information Guide, 1960 (Research Planning/Design Engineering and Real Property Offices, Kennedy Space Center).

Delta vehicle's weight and balance and to install pyrotechnics which required spin-stabilization. Although utilized by NASA as early as 1961, the building was officially transferred to NASA in January 1964. After the construction of a new Spin Test Facility in 1967, the former Bomarc Launching Building was used as the Delta Storage Building. Although NASA planned to convert the facility to a cryogenic test facility for the biosatellite program, NASA returned the building to the Air Force in 1976.[40]

Launch Complex 3/4 was later transferred for use as part of the Tethered Aerostat Radar System from 1983 through 1989, as were some adjacent facilities at Launch Complex 1/2 (see HAER FL-8-8). Apparently Launch Complex 3/4 was used a decade earlier for experiments with tethered balloons, as seen in Figure 11. A Tethered Balloon Facility (No. 2825) was constructed at the site in 1971. It consisted of a large circular track with a mooring point in the center for the balloon. A Ground Support building (No. 2826) was constructed at the center of the track in 1983.

The Tethered Aerostat Radar System is an on-going balloon-borne radar system with a two-fold purpose. It is intended to provide low level radar surveillance data in support of the United States' drug interdiction program with a secondary mission of providing the North American Aerospace Defense Command with surveillance coverage to support air sovereignty in the Florida Straits. The program started in Cudjoe Key, Florida, in December 1980. The aerostat site at Cape Canaveral was established in 1983, but was deactivated by 1989. The former Bomarc Launching Building (Facility No. 2841) was converted to serve as the Radar Maintenance Building while Launch Pad 3 (Facility No. 4101) was utilized as a tethered balloon facility. At Cape Canaveral, the large helium-filled fabric balloon was capable of rising to a height of approximately 15,000' while tethered by a cable with a maximum breaking strength of 26,000 pounds. The normal operating height was approximately 12,000'. Referred to as "Fat Albert," the Cape Canaveral balloon was approximately 175' long x 58' across the hull. The aerostat lifted a payload of approximately 1,200 pounds to an operating altitude for low-level radar coverage. The radar data collected by the aerostat was transmitted to a blockhouse ground station below, where a flight controller monitored the balloon's performance. The radar data was then digitized and

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[40] United States Air Force, Property Cards 1540F and 2841, Launch Complex 3/4 files; Pan American World Airways, Inc., *Basic Information Guide*, 1960; NASA, 1974, 9-130-135; NASA, 1967, 10-17-18; Lethbridge, "Bomarc A Fact Sheet," 1998; Lethbridge, "Delta Fact Sheet," 1998; Lethbridge, "Delta Program Background," 1998.

provided to the various federal agencies for their use.[41] Both the Tethered Balloon Facility and the Ground Support Building appear to be abandoned, and the building is vacant.

The Blockhouse was periodically used for office and training space, but has not been altered since 1992.[42] A small refurbishment project was carried out on the Blockhouse in 2003–2004.[43] In 2015, the Blockhouse was categorized as a Missile/Space Research Test facility and as Warehouse Supply and Equipment storage facility. The building is vacant.

The Bomarc Launching Building/Radar Maintenance Building (Facility No. 2841) was subsequently used for storage during the 1990s prior to its reassignment to the rocket restoration project of th1e Air Force Space and Missile Museum in 2001.[44] It has since reverted to storage as a Warehouse Supply and Equipment facility, and is partially utilized. The High Pressure Air Building/Small Engine Repair Building (Facility No. 2805) is also categorized as a vacant Warehouse Supply and Equipment facility after being occupied by subcontractor Red River Refuse for office space and the repair of dumpsters. The Blockhouse (Facility No. 4100), the Launch Pads (Facilities No. 4101 and No. 2840), the Compressor and Cooling Building/POL Building (Facility No. 2842), the High Pressure Air Building (No. 2805), and the High Pressure Air Facility remain in place, although all instrumentation has been removed and the facilities are vacant. The original wood frame Blockhouse, Electric Substation (Facility No. 2810), Boiler House, Launch Support Building, and Launch Shelter No. 2 have been removed with only a few concrete pads remaining to mark some of the original locations. Although the machinery associated with the missile programs has been removed from the buildings at Launch Complex 3/4, the site remains largely intact.

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[41] Cleary, 2001; Butowsky, National Register Nomination, 113; United States Air Force, Property Cards 01-1540, 1540F, 2841,4101, 2003; Hartmann, 2003; McCormick, 2003.

[42] United States Air Force, Property Card 4100, Launch Complex 3/4 files.

[43] Technical Engineering and Spacelift Services, *CONS – Restore Complex 1,2,3,4 Facilities 4100 and 4140,* Drawings (2003), U.S. Air Force, 45th Space Wing, Patrick AFB, Florida.

[44] United States Air Force, Property Cards 1540F and 2841, Launch Complex 3 and 4 files; Real Property Cards, Cape Canaveral Air Force Station; Pan American World Airways, Inc., *Basic Information Guide*, 1958; Pan American World Airways, Inc., *Basic Information Guide*, 1960; Master Planning, 2000.

ARCHITECTURAL DESCRIPTION OF LAUNCH COMPLEX 3/4

Launch Complex 3/4 consists of two concrete launch pads serviced by one Blockhouse. According to the 1958, 1959, and 1960 *Basic Information Guides* and the Real Property Inventory Card from the late 1950s, ancillary structures included Tunnels, a Launching Building, a Compressor and Cooling Building, Boiler House, Electric Substation, High Pressure Air Building, Launch Support Building, a Septic Tank and Drain Field, Launch Shelter No. 2, and a High Pressure Air Facility.[45] Presently, original buildings remaining are the two Launch Pads (Facilities No. 4101 and No. 2840) and their Tunnels, the Blockhouse (Facility No. 4100), the Bomarc Launching Building (No. 2841), the High Pressure Air Building (Facility No. 2805), the Paint, Oil and Lubrication (POL) Building (Compressor and Cooling Building; Facility No. 2842), High Pressure Air Facility, a Septic Tank (Facility No. 4102), and vestiges of the electrical, water, and fire suppression systems remain, in a deteriorated condition. The Boiler House, Launch Support Building, and Launch Shelter No. 2 are no longer extant.[46] Two later facilities also remain: the Tethered Balloon Facility (No. 2825; 1971) and the Ground Support Building (No. 2826; 1983). Access to facility interiors was not possible due to safety concerns.

Launch Facilities and Blockhouse

Launch Pads and Tunnels (Facilities No. 4101 and No. 2840)

As the first launch pad at Cape Canaveral, Launch Pad 3 (Facility No. 4101) was constructed between 1950 and 1951. Although not fully completed, the first Cape Canaveral launch occurred from Pad 3 with the launch of Bumper 8 on July 24, 1950. During the first several months of operation, the complex remained relatively simple. Workers initiated construction by digging a series of underground access tunnels and a compartmentalized cement box with equipment rooms. Once constructed, the area around it was backfilled with sand and a reinforced concrete launch

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[45]United States Air Force, "Real Property Accountable Record-Inventory Detail," Property Card 01-1540, Launch Complex 3/4 files, Space Gateway Support Company, GIS Real Property Office, John F. Kennedy Space Center; Pan American World Airways, Inc., *Basic Information Guide, 1958,* (Cape Canaveral Missile Test Annex, 1958), Research Planning/Design Engineering and Real Property Offices, Kennedy Space Center; Pan American World Airways, Inc., *Basic Information Guide, 1959,* (Cape Canaveral Missile Test Annex, 1959), Research Planning/Design Engineering and Real Property Offices, Kennedy Space Center; Pan American World Airways, Inc., *Basic Information Guide, 1960*, (Cape Canaveral Missile Test Annex, 1960), Research Planning/Design Engineering and Real Property Offices, Kennedy Space Center.

[46] Master Planning, *CCAFS Basic Information Guide: Facilities at CCAFS and KSC*. KSC GP-14-2 (Kennedy Space Center: Space Gateway Support, October 2000); Al Hartmann, volunteer, Air Force Space and Missile Museum, Interview by author, 30 April, 27 May, and 16 June 2003, CCAFS, Notes from interview and e-mail, Archaeological Consultants, Inc., Sarasota.

pad approximately 100'-0" x 100'-0" was then poured over the structure. With 1,111 square yards of space, the Pad was constructed at a cost of approximately $29,051. The water deluge system consisted of curbed areas bordering the Launch Pad which funneled runoff to a catch basin. Although the Launch Pad was complete, the tunnels holding electrical circuitry and high pressure air originally extended only to the edge of the launch area. At this point, the cables were placed on the ground and extended approximately 400'-0" northwest to a wood frame temporary firing room measuring 20'-0" x 20'-0" surrounded by a sand embankment. This building was removed after the construction of the permanent blockhouse immediately southeast.[47]

Modifications to the electrical systems and tunnels at Launch Pad 3 continued into 1952 as work progressed on the construction of Launch Pad 4, the tunnel system to connect the two Launch Pads, and the permanent Blockhouse. Built between September 1951 and September 1952 at a cost of approximately $29,209, Launch Pad 4 (Facility No. 2840) was approximately 200'-0" x 100'-0" of 8-½" thick reinforced concrete set over a tunnel system containing electrical circuitry and high pressure air. An area measuring 300'-0" x 182'-0" surrounding Pad 4 was paved with 8" of bituminous aggregate over 6" of limerock providing 4,515 square yards of paved surface.[48]

Constructed at a cost of $97,257, the Tunnel system connecting the two Launch Pads with the Blockhouse held hydraulic control lines, carbon dioxide (CO_2) lines, potable and firefighting water lines, a sprinkler system, and transformer and CO_2 storage rooms (Figure 12). The underground tunnels and rooms were accessible via stainless steel hatches built flush into the surface of the launch pad. The reinforced concrete tunnels under Launch Pad 3 were 4'-0" wide x 6'-8" high and formed an "H" under the pad with two east-west lateral tunnels. The concrete tunnels under Pad 4 were 5'-8" x 6'-8" set in an "H" pattern with two east-west lateral tunnels. The tun-

[47] Sverdrup & Parcel, Inc., *Joint Long Range Proving Ground*, Drawings 01-01540-003, 01-01540-004, 01-01540-005, and 01-01540-006, (1953), Research Planning/Design Engineering Office, Kennedy Space Center; "Range Facilities at Station No. 1," MTTP, Long Range Proving Ground, 1951, (45th Space Wing History Office, Patrick AFB); United States Air Force, Property Cards 01-1540, 1540 Tunnels, and 1535, Launch Complex 3/4 files; Real Property Cards, Cape Canaveral Air Force Station, (45th Space Wing Office of History, Patrick AFB); E.R. Bramlitt, *History of Canaveral District 1950-1971*, (South Atlantic Division, U.S. Army Corps of Engineers, 1971) 1-2, 14; Clifford J. Lethbridge, "Launch Pad 3 Supports the First Rocket Launch from Cape Canaveral," Spaceline.org, Spaceline, Inc., 2000; Mark Cleary, "Eastern Range Launches," (45th Space Wing Office of History, Patrick AFB, 11 December 2002); Hartmann 2003.

[48] Sverdrup & Parcel, Inc, Drawings 01-01540-003, 01-01540-004, 01-01540-005, and 01-01540-006; "Range Facilities at Station No. 1," 1951; United States Air Force, Property Cards 01-1540, 1540 Tunnels, and 1536, Launch Complex 3/4 files; Real Property Cards, Cape Canaveral Air Force Station, (45th Space Wing Office of History, Patrick AFB).

nels under Launch Pads 3 and 4 joined approximately 150' in front of the Blockhouse to form one 6'-8" high x 5'-0" wide tunnel which extended to the north side of the Blockhouse.[49]

Following the conclusion of missile testing at the complex in 1962, Pads 3 and 4 were converted to serve as helicopter landing pads assigned to the Mercury Rescue Unit in support of the Mercury manned launches.[50] Launch Pad 3 was later converted to serve as part of the Tethered Aerostat Radar System operational at Cape Canaveral from 1983 to 1989.[51]

Bomarc Launching Building/Delta Spin Balance Facility/Radar Maintenance Building (Facility No. 2841)

Constructed at a cost of $226,196, the Bomarc Launching Building, also known as Launch Pad 4A, is now a Warehouse Supply and Equipment storage facility (No. 2841). With an area of 2,690 square feet, the building was uniquely constructed to launch the Bomarc missile with a roof that could split right and left down the middle, allowing the missile to be raised prior to a quick launch.

Set on a concrete slab, the north, south, and east walls of the building were constructed of reinforced concrete. A large cargo door on the east facade allowed the missile trailer to be backed into the building (Figure 13). A Shelter Crane and Lifting Beam then lifted and positioned the missile onto the Launcher Erector in preparation for firing. A one-story concrete-block extension with a shed roof was located on the south wall. The roof and west façade were constructed of metal panels and corrugated metal with a central opening. The west façade and roof would rotate on rails to provide an opening through which the Bomarc would be launched (Figure 14). The Bomarc Launching Building was constructed between 1955 and 1957 with the first launch of a Bomarc from the structure in September 1958. It continued to launch the Bomarc missile into 1959.[52]

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[49] Sverdrup & Parcel, Inc., Drawings 01-01540-003, 01-01540-004, 01-01540-005, and 01-01540-006; "Range Facilities at Station No. 1," 1951; United States Air Force, Property Cards 01-1540, 1540 Tunnels, and 1536, Launch Complex 3/4 files.

[50] United States Air Force, "Real Property Voucher," Voucher Nos. 63-1046, Space Gateway Support Company, GIS Real Property Office, John F. Kennedy Space Center.

[51] United States Air Force, Property Cards 4101 and 2840, Launch Complex 3/4 files.

[52] National Aeronautics and Space Administration (NASA), "Technical Facilities Catalog, Volume 2," (Washington, DC: NASA, 1974), 9-130-135; National Aeronautics and Space Administration (NASA), "Technical Facilities Catalog, Volume 2," (Washington, DC: NASA, 1967), 10-17-18; Clifford J. Lethbridge, "Cape Canaveral Launch Sites Box Scores," Spaceline.org, Spaceline, Inc., 2001; "Launch Shelter Handling," in *Bomarc Launch Manual*, (1959), 33-38.

Although this type of shelter was initially used, it proved too expensive to construct and maintain. Subsequent launching facilities utilized a simple structure with a sliding roof. As the U.S. Air Force declared the missile operational, the Bomarc was deployed to bases throughout the United States in 1960. Consequently, the Launching Building was reassigned and altered to serve as the Delta Spin Balance Facility for the Delta program which was introduced in 1959 by the National Aeronautics and Space Administration (NASA). Based on the Thor Intermediate range ballistic missiles (IRBM), Douglas Aircraft designed the Delta (originally called the Thor-Delta) vehicle specifically for civilian and commercial satellite payloads launched by NASA. NASA utilized the former Bomarc Launching Building to conduct spin tests on the Delta vehicle's weight and balance and to install pyrotechnics which required spin-stabilization. In 1962, a concrete-block and earthen revetment was constructed immediately east of the Launch Shelter, between the Shelter and Pad 4. NASA installed a pneumatic crane with two, two-ton hoists in the facility and constructed an open addition with a shed roof on the south façade in 1963. Although utilized by NASA as early as 1961, the building was officially transferred to NASA in January 1964. After the construction of a new Spin Test Facility in 1967, the former Bomarc Launching Building was used as the Delta Storage Building. As early as 1966, NASA planned to convert the facility to a cryogenic test facility for the biosatellite. The building was returned to the Air Force in 1976.[53]

With the conversion of Launch Complex 3/4 for use as part of the Tethered Aerostat Radar System from 1983 through 1989, the former Bomarc Launching Building was converted to serve as the Radar Maintenance Building. Subsequently used for storage, it was reassigned to the rocket restoration project of the Air Force Space and Missile Museum in 2001.[54]

Blockhouse (Facility No. 4100)

Completed by August 1951 at an approximate cost of $115,204, the permanent Blockhouse (Facility No. 4100), with 3,115 square feet of space, housed the communications, instrumentation, and control consoles. Located approximately 200' from the Launch Pads, the reinforced concrete Blockhouse, with its domed reinforced concrete roof, was partially inset in the ground on a con-

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[53] United States Air Force, Property Cards 1540F and 2841, Launch Complex 3 and 4 files; Pan American World Airways, Inc., *Basic Information Guide*, 1960; NASA, 1974, 9-130-135; NASA, 1967, 10-17-18; Clifford J. Lethbridge, "Bomarc A Fact Sheet," Spaceline.org, Spaceline, Inc., 1998; Clifford J. Lethbridge, "Delta Fact Sheet," Spaceline.org, Spaceline, Inc., 1998; Clifford J. Lethbridge, "Delta Program Background," Spaceline.org, Spaceline, Inc., 1998.

[54] United States Air Force, Property Cards 1540F and 2841, Launch Complex 3 and 4 files; Real Property Cards, Cape Canaveral Air Force Station; Pan American World Airways, Inc., *Basic Information Guide*, 1958; Pan American World Airways, Inc., *Basic Information Guide*, 1960; Master Planning, 2000.

crete foundation (Figure 15). The Blockhouse incorporated a Firing Room, an Intelligence Room, and two Equipment Rooms separated by an open passageway from a concrete-block Ready Room (Figure 16).

Within the Blockhouse, the interior walls remained unfinished with the concrete exposed. The floor and ceiling of the two Equipment Rooms and the open passageway remained exposed concrete. Ceilings of the Intelligence Room and Firing Room were covered with acoustical tile, while the floors had inset cabling trenches covered with asphalt tile. The concrete-block Ready Room had a flat built-up roof, a concrete slab foundation, and two-light wood awning and three-light wood awning windows. The interior had exposed concrete-block walls, an acoustical tile ceiling, and an asphalt tile floor. Operating as the launch control center, the Blockhouse had controls for firefighting equipment, CO_2 equipment, and missile firing consoles (Figure 17). The two mirrored vision ports, one direct vision port, and a ladder to the top of the domed roof provided a view of the Launch Pads.[55] A Septic Tank (Facility No. 4102) with a capacity of 3,000 gallons served the Blockhouse.[56]

In 1961, the complex was reassigned to serve the Mercury program. In August 1961, the Blockhouse was converted to serve as the Dispensary (also known as the Forward Medical Station), and the Ready Room was subsequently modified in 1962. The hoods over the mirrored vision ports have been removed. With the exception of periodic training tenants, the building has remained vacant since around 1967.[57]

Ground Support Equipment

Electrical, water, and fire suppression systems supported the activities at Launch Complex 3/4. A Water Storage Reservoir and Firefighting Water Pump Station served the entire launching area and were located northwest of Launch Complex 3/4. A Potable Water Pump Station was situated southwest of the complex along Central Control Road. The Potable Water Distribution System extended 180' throughout the complex which had a drainage system of 12,503'. The fire protec-

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[55] United States Air Force, Property Cards 01-1540 and 4100, Launch Complex 3/4 files; “Range Facilities at Station No. 1,” 1951; Pan American World Airways, Inc., *Basic Information Guide*, 1958; Pan American World Airways, Inc., *Basic Information Guide*, 1959; Pan American World Airways, Inc., *Basic Information Guide*, 1960; “Eastern Test Range Launch Complexes, Cape Canaveral AFS,” (45th Space Wing Office of History, Patrick AFB, 16 April 1991); Sverdrup & Parcel, Inc., Drawings 01-01540-003, 01-01540-004, 01-01540-005, and 01-01540-006; Bramlitt, 1-2, 14; Hartmann 2003.

[56] United States Air Force, Property Cards 01-1540 and 4102, Launch Complex 3/4 files.

[57] United States Air Force, Property Cards 01-1540 and 4100, Launch Complex 3/4 files.

tion system was composed of 1,418' of Fire Protection Water Mains, 2,536' of wiring for a Fire Alarm System, Fire Alarm Boxes, and Fire Hydrants.[58] The reservoir is mostly gone, and the remnant retains only a small amount of water. The Water Storage Tank was removed between 1971 and 1973, and the Firefighting Water Pump Station was removed between 1979 and 1981.[59]

Compressor and Cooling Building/Paint, Oil, and Lubrication (POL) Building (Facility No. 2842)

The Compressor and Cooling Building/POL Building identified on the 1960 *Basic Information Guide* is now a storage building (Facility No. 2842). Constructed after 1955, the concrete-block building, with 130 square feet of interior space, is set on a concrete slab foundation and topped by a shed roof.[60] The building is presently vacant.

High Pressure Air Building/Small Engine Repair Building/Warehouse Supply and Equipment (Facility No. 2805) and the High Pressure Air Facility

The High Pressure Air Building evident in the 1960 *Basic Information Guide* was the Small Engine Repair Building (Facility No. 2805) in 2000, but is now a storage facility according to the Real Property Office (Figure 18). Historic photographs reveal that it was constructed after 1955. Originally, this structure was a small building with a flat roof, louvered vents, a covered overhang on the south façade, and one entrance on the north façade; this building has been significantly enlarged since the 1950s. With 1,496 square feet of space, this concrete-block building has a continuous concrete-block foundation and a gable roof surfaced with composition shingles. Replacement windows on the west facade are two-over-two-light, single-hung sash. A cargo door is located on the north facade. The building is presently vacant. The High Pressure Air Facility noted in the 1960 *Basic Information Guide* was located immediately west of the High Pressure Air Building. The facility, which is apparent in photographs dating to 1955, consisted of con-

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[58] United States Air Force, Property Cards 01-1540, Launch Complex 3/4 files; "Range Facilities at Station No. 1," 1951.

[59] Pan American World Airways, Inc., *Basic Information Guide* for the years 1963–1981. Cape Canaveral.

[60] United States Air Force, Property Cards 01-1540 and 2842, Launch Complex 3/4 files; Pan American World Airways, Inc., *Basic Information Guide*, 1960; Master Planning, 2000.

crete-block blast walls which enclosed a concrete slab on the north and south within which bottles of CO_2 were stored (Figure 19).[61]

Electric Substation (Facility No. 2810)

The Electric Substation (Facility No. 2810) was situated southeast of the High Pressure Air Building (Facility No. 2805) (Figure 20). Erected in 1955, the Electric Substation has been removed since 2000; only the concrete slab foundation and a few pieces of equipment remain.[62] The Electric Substation provided electrical power which was distributed throughout the complex by 6,369' of Electrical Distribution Lines.[63]

Boiler House, Launch Support Building, and Launch Shelter No. 2

According to the 1960 *Basic Information Guide*, the concrete-block Boiler House was located south of the High Pressure Air Building. Constructed after 1955, it was removed by 1981.[64] The Launch Support Building was a metal structure set on a reinforced concrete foundation located on Launch Pad 4 (Figure 21). Constructed after 1955, it was relocated to the Industrial Area in 1963.[65] Typical of temporary structures utilized at Air Force bases throughout the post-World War II era, Launch Shelter No. 2 was a temporary metal shelter on rails covered by a canvas awning (Figure 22). Constructed after 1955, Launch Shelter No. 2 was identified in the 1960 *Basic Information Guide*. As a mobile facility, this structure was used at Pad 4 to provide cover for a launch vehicle during checkout and preflight operations. The structure was not included on

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[61] United States Air Force, Property Cards 01-1540 and 2805, Launch Complex 3 and 4 files; Pan American World Airways, Inc., *Basic Information Guide*, 1960; Master Planning, 2000; Photographs 54-CPX03 and 04-001-ah, a089697 and a089703, University of Central Florida, Florida Space Coast History Project, scanned copy provided courtesy of Al Hartmann.

[62] Pan American World Airways, Inc., *Basic Information Guide, 1960*; Master Planning, 2000.

[63] United States Air Force, Property Cards 01-1540, Launch Complex 3 and 4 files.

[64] Pan American World Airways, Inc., *Basic Information Guide*, 1960; Pan American World Airways, Inc., *Basic Information Guide*, 1981; Photograph 54-CPX03 and 04-001-ah, University of Central Florida, Florida Space Coast History Project, scanned copy provided courtesy of Al Hartmann.

[65] Pan American World Airways, Inc., *Basic Information Guide*, 1960; United States Air Force, Property Card 01-1540, Launch Complex 3/4 files; Photographs a089697 and 54-CPX03 and 04-001-ah, University of Central Florida, Florida Space Coast History Project, scanned copy provided courtesy of Al Hartmann.

the Real Property Inventory Card from the late 1950s, and may have been moved to another launch facility following the deactivation of Pad 4.[66]

Subsequent Construction, Modifications, And Deactivation

Between 1950 and 1960, Launch Pads 3 and 4 were used to serve the Bumper, Matador, Bomarc, Lark, X-17, Polaris FTV, and Redstone missile programs. At the close of these missile programs, facilities at Launch Complex 3/4 were reassigned to serve the Mercury Rescue Unit for the Mercury manned launches. In support of this program, Launch Pads 3 and 4 functioned as helicopter landing areas. In August 1961, the Blockhouse was converted to the Dispensary, also known as the Forward Medical Station, and the Ready Room was subsequently modified in 1962. With the exception of periodic training tenants, the building has remained vacant since 1967 and has been considered "sterile" since 1974.[67] A small project to restore the Blockhouse (Facility 4100) was carried out on in 2003–2004 for preservation purposes. During this project, the Launch Complex 3/4 Blockhouse received a new storm sewer line, the viewing mirrors were replaced, and the mirror assemblies were refurbished along with the associated windows, and an exterior door was replaced.[68]

The Bomarc Launch Shelter was converted to the Spin Balance Facility for NASA's Delta program which was introduced in 1959. Following the construction of new facilities for the Delta program, the building was used for storage, and then was utilized by NASA. In December 1963, the Launch Support Building was relocated to the Industrial Area. The Boiler House and Launch Shelter No. 2 were subsequently removed from the complex.[69]

Launch Complex 3/4 was configured for use as part of the Tethered Aerostat Radar System between 1983 and 1989, as were some adjacent facilities at Launch Complex 1/2 (see HAER FL-8-

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[66] Pan American World Airways, Inc., *Basic Information Guide, 1960*; United States Air Force, Property Card 1540, Launch Complex 3/4 files; Photographs a089703 and 54-CPX03 and 04-001-ah, University of Central Florida, Florida Space Coast History Project, scanned copy provided courtesy of Al Hartmann.

[67] United States Air Force, "Real Property Voucher," Voucher Nos. 62-1058 and 63-1046; United States Air Force, Property Cards 01-1540,1536, 2840, 1535, 4101, and 4100, Launch Complex 3/4 files; Pan American World Airways, Inc., *Basic Information Guide*, 1960.

[68] Technical Engineering and Spacelift Services, *CONS – Restore Complex 1,2,3,4 Facilities 4100 and 4140,* Drawings (2003).

[69] United States Air Force, Voucher No. 64-1313; United States Air Force, Property Cards 01-1540, 1540F, and 2841, Launch Complex 3 and 4 files; Pan American World Airways, Inc., *Basic Information Guide*, 1981*;* Clifford J. Lethbridge, "Delta Fact Sheet", Spaceline.org, Spaceline, Inc., 1998; Harry Butowsky, National Register of Historic Places Nomination Form/National Historic Landmark Federal Agency Nomination: Cape Canaveral Air Force Station (Washington, D.C.: National Park Service, 1983), 7:3, 113.

8). The Tethered Balloon Facility (Facility No. 2825) and its Ground Support Building (Facility No. 2826) were constructed immediately southeast of Launch Pads 3 and 4 in 1971 and 1983, respectively.[70] The Tethered Balloon Facility is a large, concrete, circular track flush to the ground with steel rails along the outer perimeter. The Ground Support Building is a small concrete-block building with a flat roof, equipment doors on the west facade, and a small window on the north facade. The Bomarc Launching Building (Facility No. 2841) was altered to serve as the Radar Maintenance Building, and the High Pressure Air Building (Facility No. 2805) was reused as the Small Engine Repair Building.[71] With the exception of the Blockhouse, the other buildings associated with Launch Complex 3/4 have been altered to serve new uses. The Blockhouse and Launch Pads of Launch Complex 3/4 are now abandoned. Although the electrical and computerized equipment associated with the missile program has been removed from the Blockhouse, the original interior materials and finishes remain largely intact, although in a much deteriorated state. In addition, most of the layout and larger facilities associated with Launch Complex 3/4 remain intact.

[70] Although the Tethered Aerostat Radar System was not operational until 1983 at this site, it appears that testing of tethered balloons at Launch Complex 3/4 began much earlier as the circular facility was constructed in 1971, and can be seen in Figure 11, taken in 1973. United States Air Force, “Tethered Aerostat Radar System,” Fact Sheet, Langley Air Force Base: Air Combat Command, Public Affairs Office, 2003. www2.acc.af.mil/library/factsheets/tars.html.

[71] Mark Cleary, “45th Space Wing: Its Heritage, History & Honors 1950-2001, Launch Facilities & Programs: Complexes 3 and 4” (45th Space Wing Office of History, Patrick AFB, 2001); United States Air Force, Property Cards 2825 and 2826, Launch Complex 3 and 4 files; Master Planning, 2000.

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HISTORIC DRAWINGS

As of 2016, the technical drawings used for research in this study have not been cleared for release to the public domain. It is, therefore, not possible to reproduce in this document the drawings used to gather information about the design, construction, and use of facilities at Launch Complex 3/4, CCAFS.

APPENDIX: FIGURES FROM DATA PAGES

Figure 1. Location of Launch Complex 3/4, CCAFS. Air Force Space and Missile Museum.

Figure 2. Original wood frame firing room, ca. 1950, with Pad 3 in background on right. Photograph g-0510, A Series Boeing photographs, located at University of Central Florida, Florida Space Coast History Project.

Figure 3. Bumper 8 on Launch Pad 3, July 1950. Photograph Bumper, A Series Boeing photographs, located at University of Central Florida, Florida Space Coast History Project.

Figure 4. Liftoff of Bumper 8 on July 24, 1950. U.S. Air Force photograph, located at CCAFS Cultural Resources Office Archives.

Figure 5. Preparation of a Matador missile launch from Launch Pad 3, September 27, 1951. Note completed Blockhouse in background. Photograph 51-g-1767, located at University of Central Florida, Florida Space Coast History Project.

Figure 6. Launch of Bomarc missile from launcher stand on Pad 4, August 12, 1959. Note Launch Support Building to the right of missile launch. Photograph 59-PL-59-22259, RCA Photo, U.S. Air Force, located at University of Central Florida, Florida Space Coast History Project.

Figure 7. Bomarc missile launched from Pad 4A, 1959. U.S. Air Force photograph, located at U.S. Air Force Space and Missile Museum.

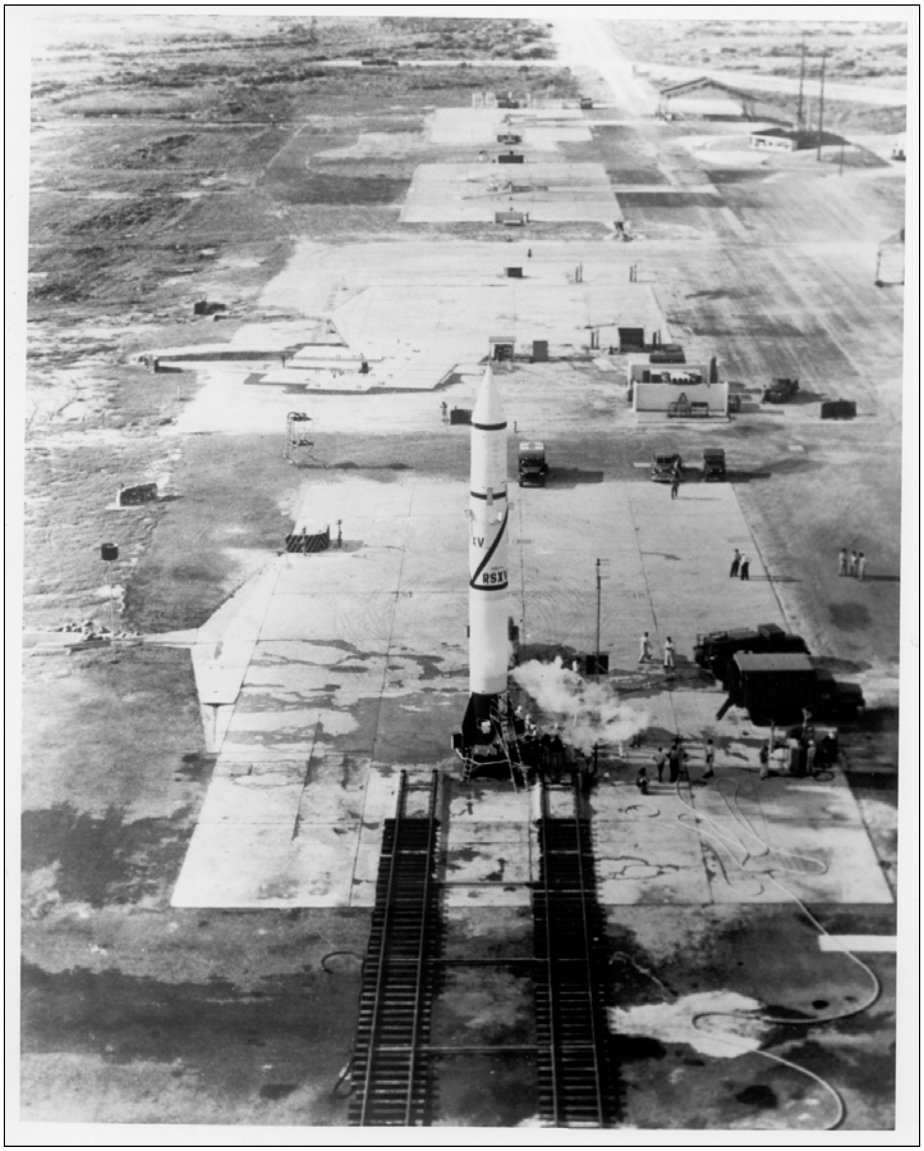

Figure 8. Preparation of a Redstone missile launch from Launch Pad 4, ca. 1954. Drainage system evident at left edge of pad. Note High Pressure Air Facility, Launch Pads 3, 2, 1, and Blockhouse Launch Complex 1/2 in background. Photograph 54-CPX03 and 04-001-ah, located at University of Central Florida.

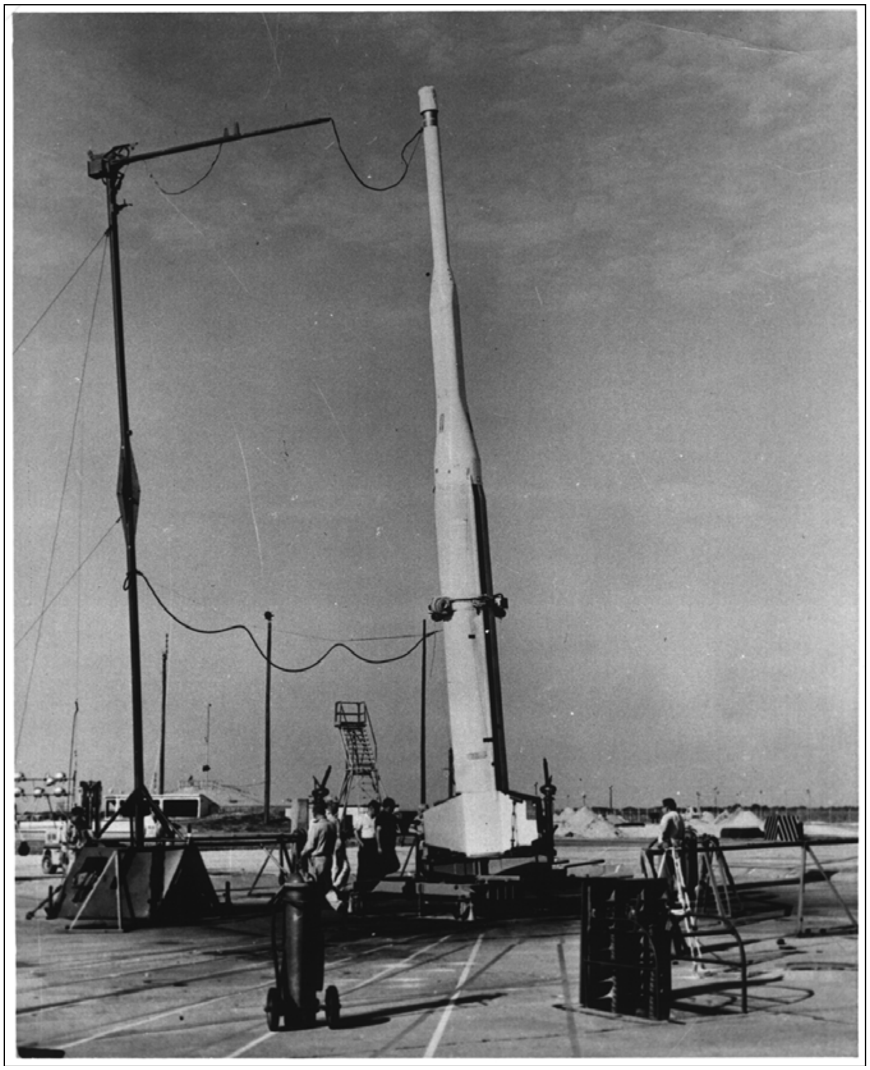

Figure 9. X-17 missile preparing for launch from Launch Pad 3, date unknown. Note Blockhouse Launch Complex 1/2 in background. Photograph X-17-001-ah, A Series Boeing photographs, located at University of Central Florida.

Figure 10. Preparation for a launch of a Lark missile from Pad 3, ca. 1950. Tank used as a firing room in foreground, Lark and launcher in background. Photograph lark-001-ah, A Series Boeing photographs, located at University of Central Florida.

Figure 11. Tethered balloon facility (ring in center) at Launch Complex 3/4 in 1973 (LC 1/2 is center right of photo). U.S. Air Force photograph, located at U.S. Space and Missile Museum.

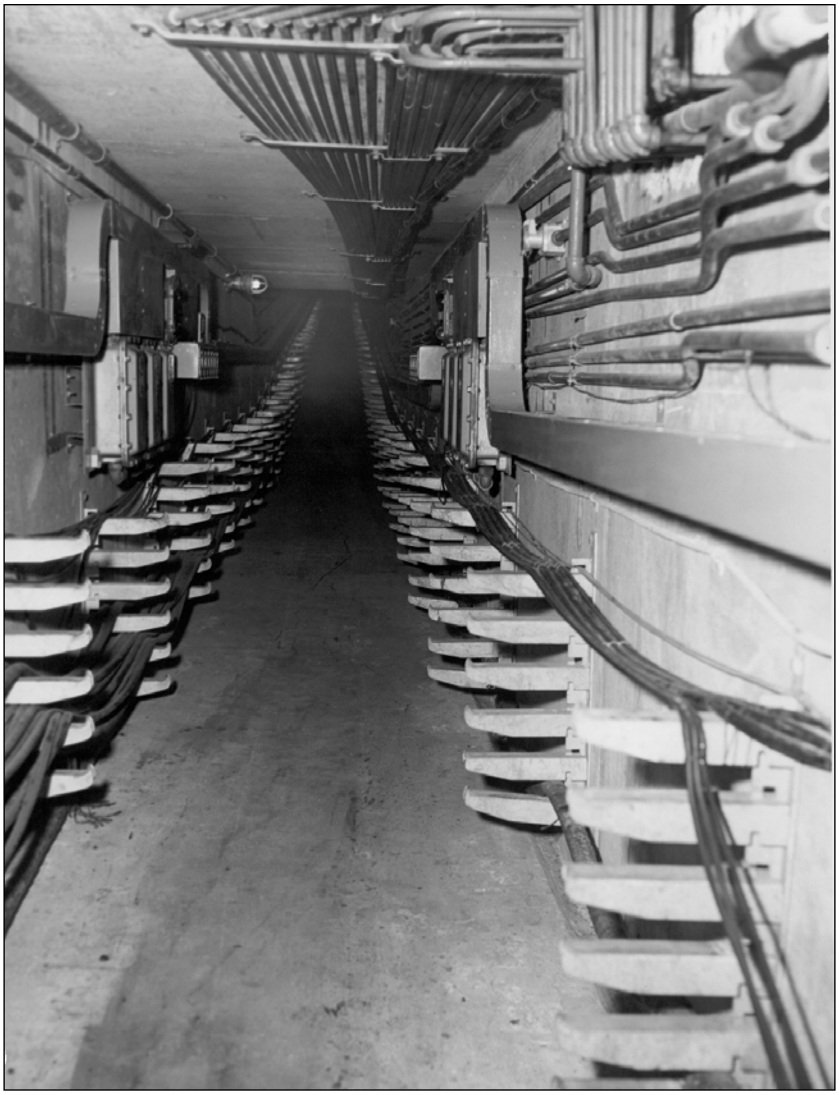

Figure 12. Interior of launch pad tunnels, date unknown. Photograph a064099, U.S. Air Force, located at University of Central Florida, Florida Space Coast History Project.

Figure 13. Bomarc missile on trailer arriving at Bomarc Launching Building, ca.1958. Photograph a101753, U.S. Air Force, located at University of Central Florida, Florida Space Coast History Project.

Figure 14. Bomarc Launching Building in preparation for a Bomarc launch, October 6, 1958. Photograph 58-PL-58-46675, RCA Photo, U.S. Air Force, located at University of Central Florida, Florida Space Coast History Project.

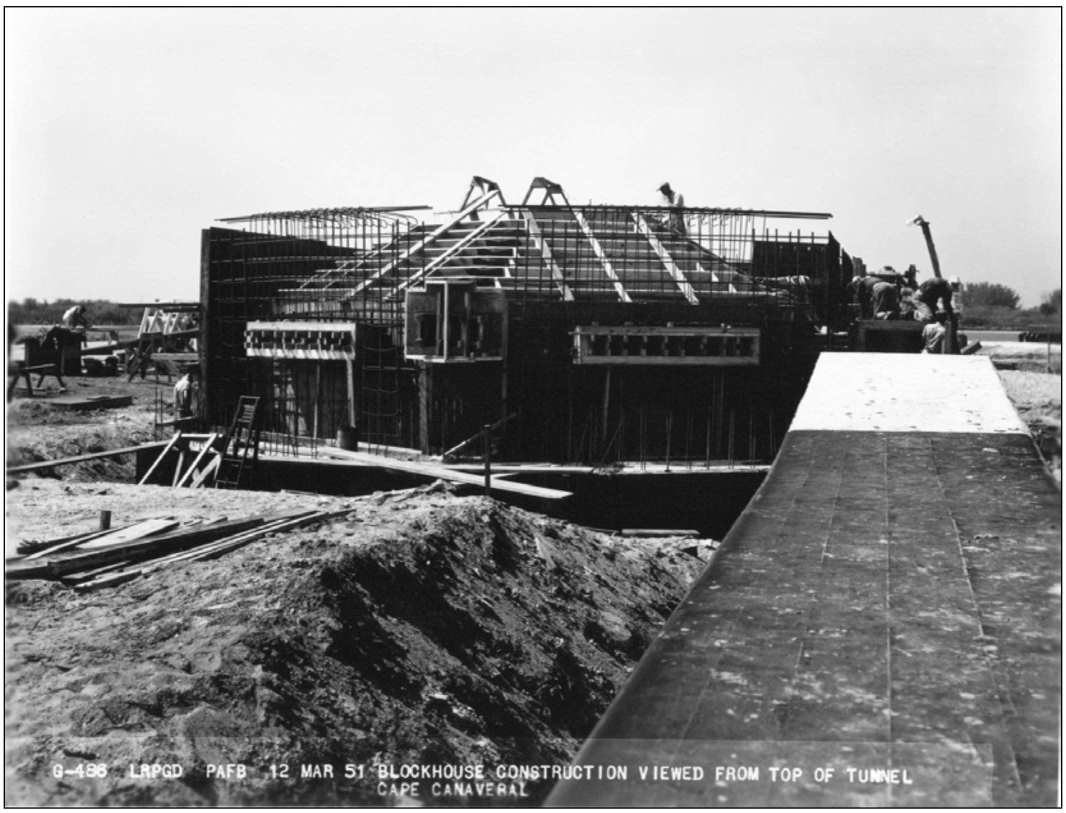

Figure 15. Launch Complex 3/4 Blockhouse construction viewed from top of Tunnel, March 12, 1951. Photograph 51-g-0486, located at 45th Space Wing History Office, Patrick Air Force Base.

Figure 16. Blockhouse and Ready Room, April 8, 1966. Photograph 116-KSC-66-7160, NASA, located at 45th Space Wing History Office, Patrick Air Force Base.

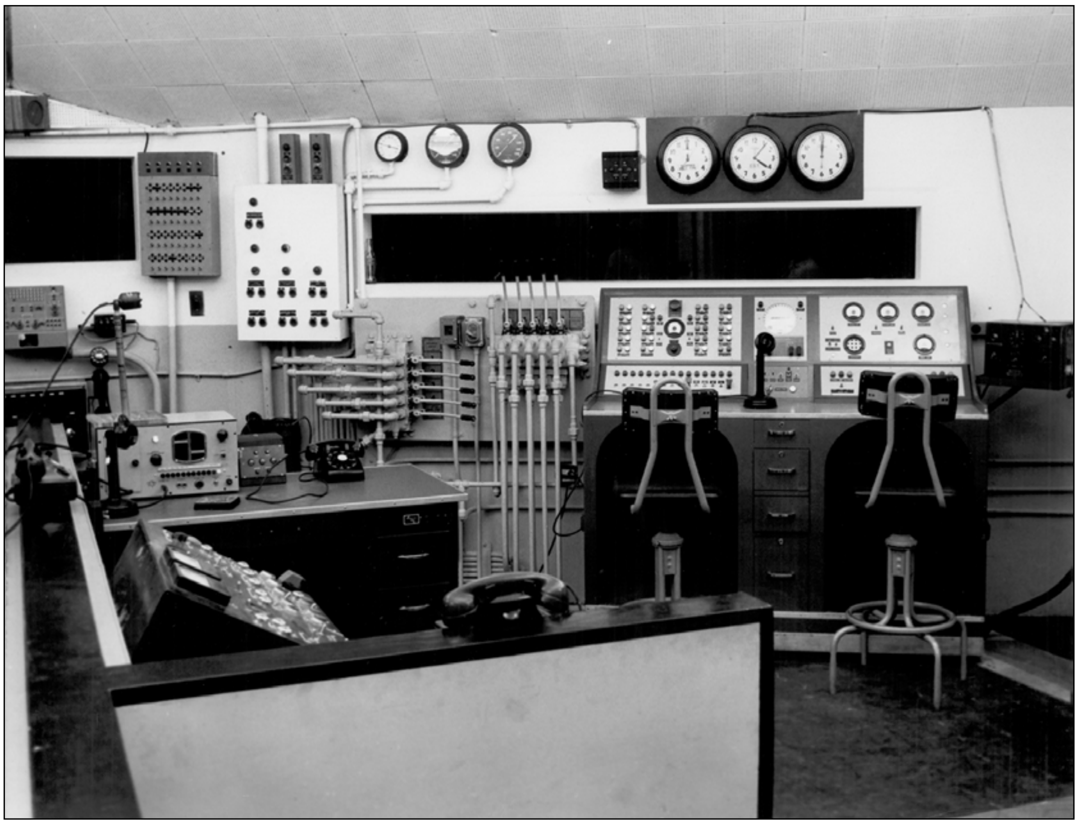

Figure 17. Launch Complex 3-4 Blockhouse, interior Firing Room. Photograph a075718, A Series Boeing Photographs, located at University of Central Florida, Florida Space Coast History Project.

Figure 18. Bomarc missile delivery to Launch Pad 4, date unknown. Note the Launch Support Building to left of missile, the High Pressure Air Building in background on left, and High Pressure Air Facility blast walls above crane in background on right. Photograph a089697, A series Boeing Photographs, located at University of Central Florida, Florida Space Coast History Project.

Figure 19. High Pressure Air Facility, date unknown. Photograph located at University of Central Florida, Florida Space Coast History Project.

Figure 20. High Pressure Air Building and Electric Substation, date unknown. Photograph located at University of Central Florida, Florida Space Coast History Project.

Figure 21. Launch Shelter No. 2 (left) and Launch Support Building at Launch Pad 4, date unknown. Photograph located at University of Central Florida, Florida Space Coast History Project.

Figure 22. Launch Complex 3/4, ca. 1956. Blockhouse and Ready Room in foreground. Launch Shelter No. 2 over missile at Launch Pad 4 in center background. Bomarc Launching Building under construction behind Pad 4. High Pressure Air Building and High Pressure Air Facility in background on right. Photograph a089703, A series Boeing Photographs, located at University of Central Florida, Florida Space Coast History Project.

CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 3/4 HAER No. FL-8-9
Northern terminus of Bumper Road (Lighthouse Road)
Cape Canaveral
Brevard County
Florida

PHOTOGRAPHS

HISTORIC AMERICAN ENGINEERING RECORD
Southeast Regional Office
National Park Service
U. S. Department of the Interior
100 Alabama Street, S.W.
Atlanta, GA 30303

HISTORIC AMERICAN ENGINEERING RECORD

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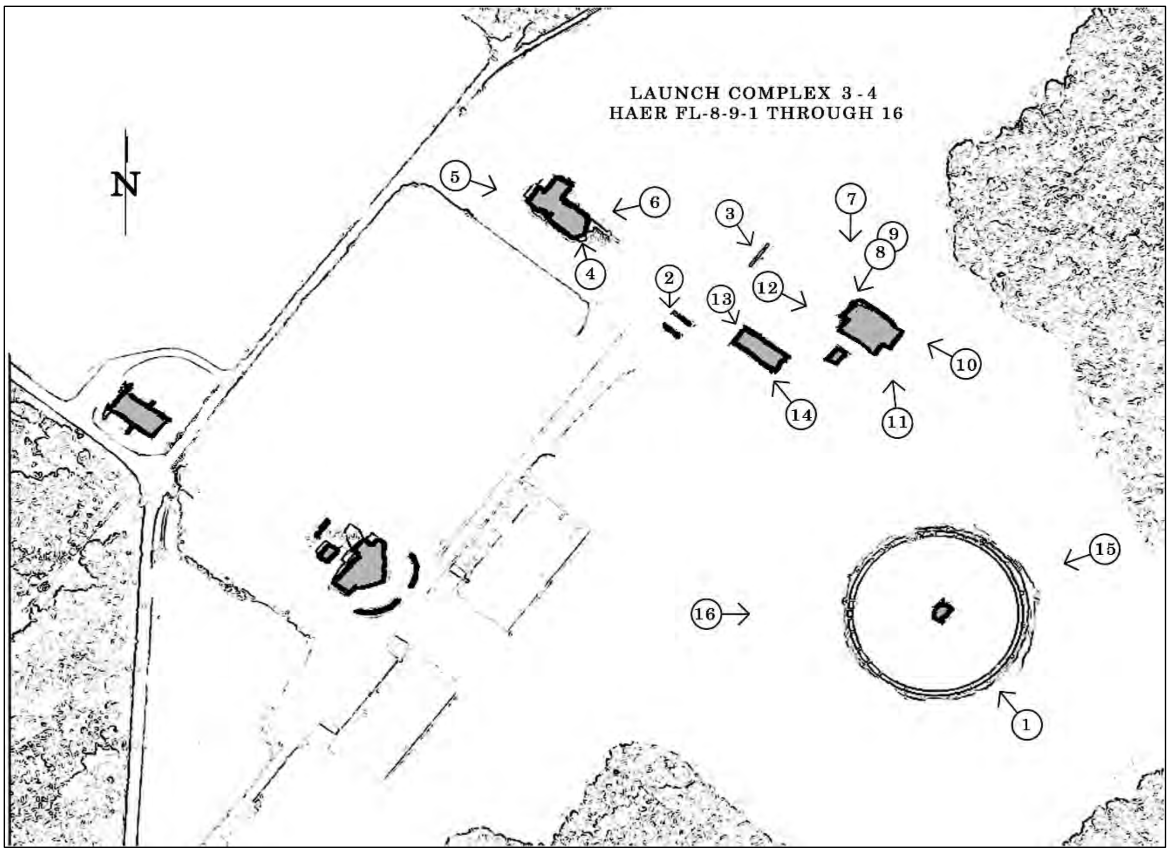
Northern terminus of Bumper Road (Lighthouse Road)
Cape Canaveral
Brevard County
Florida

INDEX TO BLACK AND WHITE PHOTOGRAPHS

Photographer: Martin Stupich, 2014
See photo key on page 2 of Index to Photographs

FL-8-9-1	PAVED CONCRETE RING FLANKED BY STEEL RAILS, TETHERED BALLOON FACILITY (No. 2825), SHOWING EXTANT LC 3/4 BUILDINGS IN DISTANCE; VIEW TO NORTHWEST (on photo key as #1)
FL-8-9-2	CONCRETE BLAST WALLS OF THE HIGH PRESSURE AIR FACILITY (No. 2805); VIEW TO SOUTH (on photo key as #2)
FL-8-9-3	LAUNCH PAD 4 SHOWING TIE DOWNS AND ATTACHMENT POINTS FOR THE BOMARC MISSILE LAUCHER AND THE CONCRETE FOUNDATION OF THE LAUNCH SUPPORT BUILDING; VIEW TO SOUTHEAST (on photo key as #3)



Photograph Key for Entire Complex.

HISTORIC AMERICAN ENGINEERING RECORD
CAPE CANAVERAL AIR FORCE STATION
LAUNCH COMPLEX 3 AND 4
SEE INDEX TO PHOTOGRAPHS FOR CAPTION
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HISTORIC AMERICAN ENGINEERING RECORD
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HISTORIC AMERICAN ENGINEERING RECORD
CAPE CANAVERAL AIR FORCE STATION
LAUNCH COMPLEX 3 AND 4
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HISTORIC AMERICAN ENGINEERING RECORD

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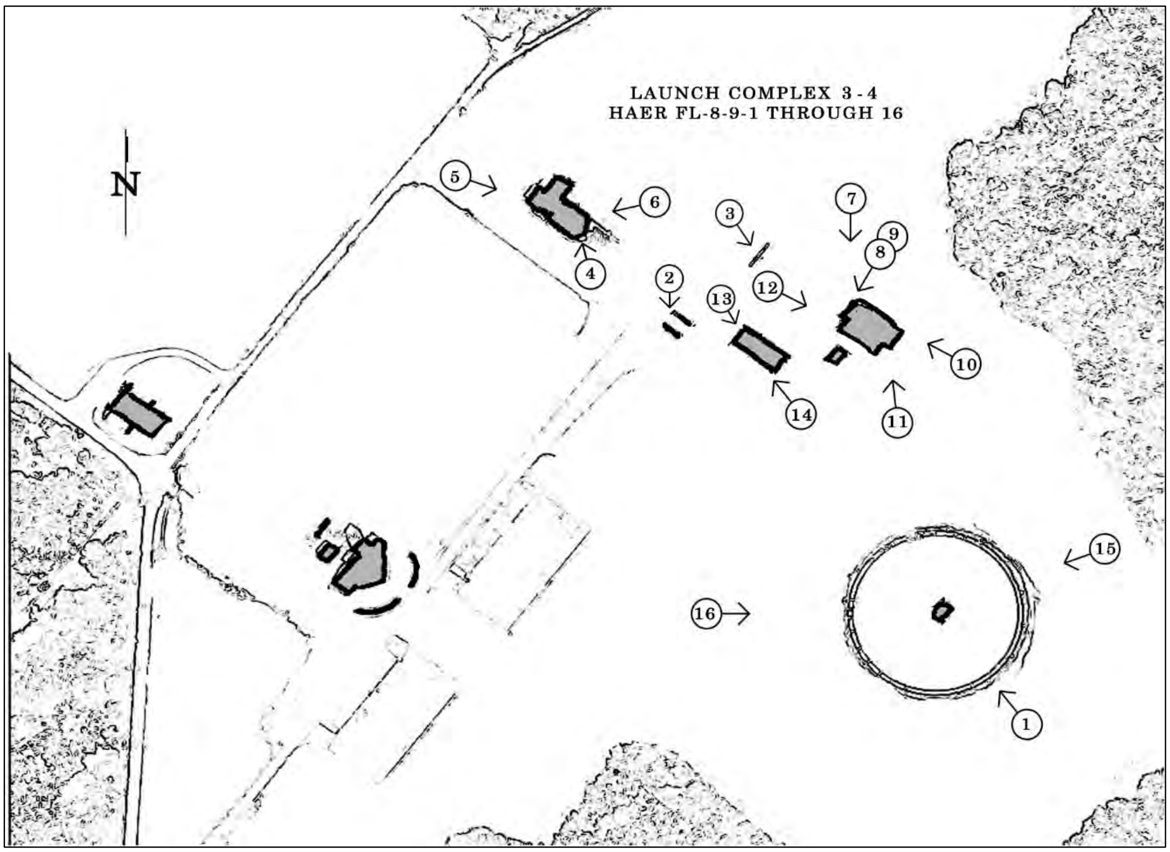
CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 3/4, FACILITY No. 4100 (LAUNCH COMPLEX 3/4, BLOCKHOUSE) — HAER No. FL-8-9-A
Northern terminus of Bumper Road (Lighthouse Road)
Cape Canaveral
Brevard County
Florida

INDEX TO BLACK AND WHITE PHOTOGRAPHS

Photographer: Martin Stupich, 2014
See photo key on page 2 of Index to Photographs

FL-8-9-A-1	BLOCKHOUSE (No. 4100) SOUTHEAST FACADE; VIEW TO NORTHWEST (on photo key as #4)
FL-8-9-A-2	BLOCKHOUSE (No. 4100) REAR WING; VIEW TO NORTHEAST (on photo key as #5)
FL-8-9-A-3	BLOCKHOUSE (No. 4100) NORTHEAST FACADE; VIEW TO SOUTHWEST (on photo key as #6)



Photograph Key for Entire Complex.

HISTORIC AMERICAN ENGINEERING RECORD
CAPE CANAVERAL AIR FORCE STATION
LAUNCH COMPLEX 3 AND 4
SEE INDEX TO PHOTOGRAPHS FOR CAPTION
HAER No. FL-8-9-A-1

HISTORIC AMERICAN ENGINEERING RECORD
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HISTORIC AMERICAN ENGINEERING RECORD

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CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 3/4, FACILITY No. 2841 HAER No. FL-8-9-B
(LAUNCH COMPLEX 3/4, BOMARC LAUNCHING BUILDING)
Northern terminus of Bumper Road (Lighthouse Road)
Cape Canaveral
Brevard County
Florida

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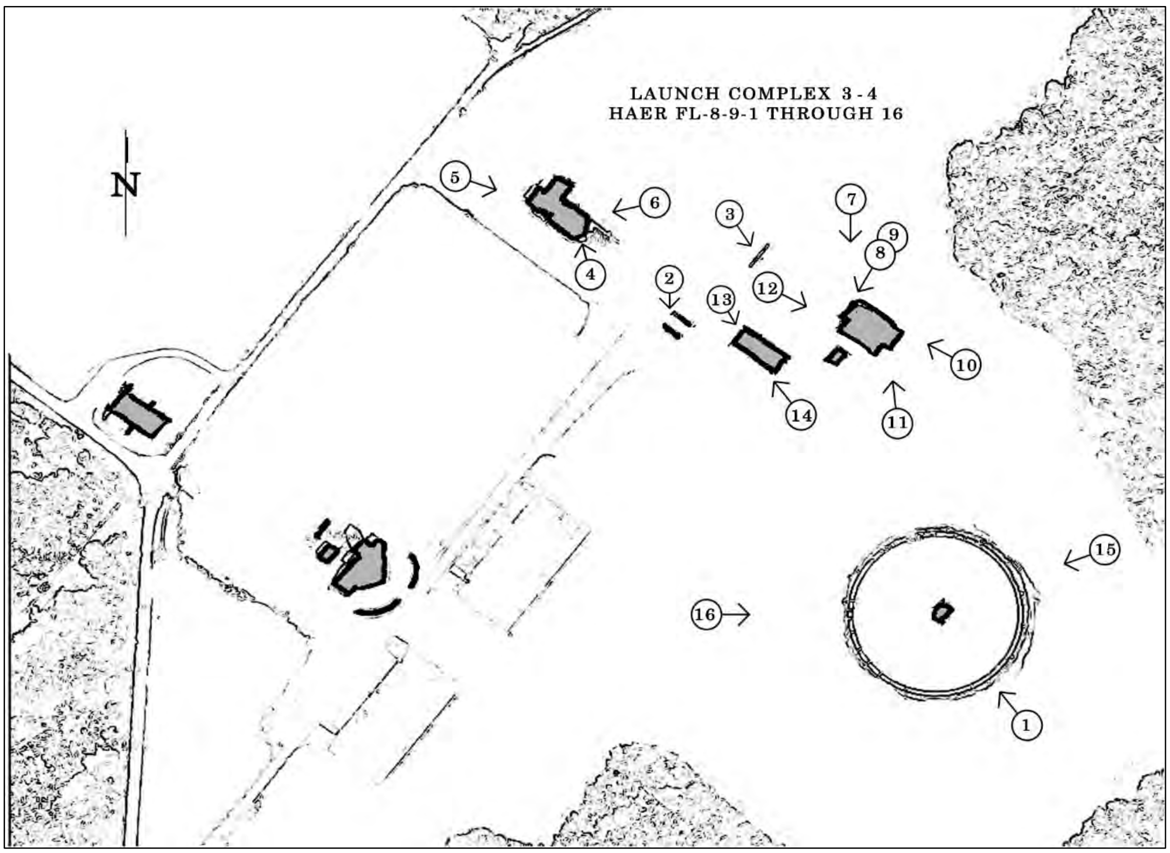
Photographer: Martin Stupich, 2014
See photo key on page 2 of Index to Photographs

FL-8-9-B-1	GENERAL VIEW OF BOMARC LAUNCHING BUILDING (No. 2841), POL BUILDING (No. 2842), AND HIGH PRESSURE AIR BUILDING (No. 2805); VIEW TO SOUTH (on photo key as #7)
FL-8-9-B-2	BOMARC LAUNCHING BUILDING (No. 2841), NORTHEAST AND SOUTHWEST FACADES, VIEW TO SOUTH (on photo key as #8)
FL-8-9-B-3	DETAIL, BOMARC LAUNCHING BUILDING (No. 2841), MASSIVE DOORS ON NORTHWEST FACADE SHOWING RAILS AND CARRIAGE WHEEL HOUSING AT LOWER PORTION OF FACADE; VIEW TO SOUTH (on photo key as #9)
FL-8-9-B-4	BOMARC LAUNCHING BUILDING (No. 2841), SOUTHEAST FACADE, VIEW TO NORTHWEST SHOWING HIGH PRESSURE AIR BUILDING (No. 2805) AND POL BUILDING (No. 2842) (on photo key as #10)
FL-8-9-B-5	GENERAL OBLIQUE VIEW BOMARC LAUNCHING BUILDING (No. 2841), SOUTH TO NORTH WITH BLAST WALL FAR LEFT; VIEW TO NORTH (on photo key as #11)



Photograph Key for Entire Complex.

HISTORIC AMERICAN ENGINEERING RECORD
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CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 3/4, FACILITY No. 2842 (LAUNCH COMPLEX 3/4, POL BUILDING)

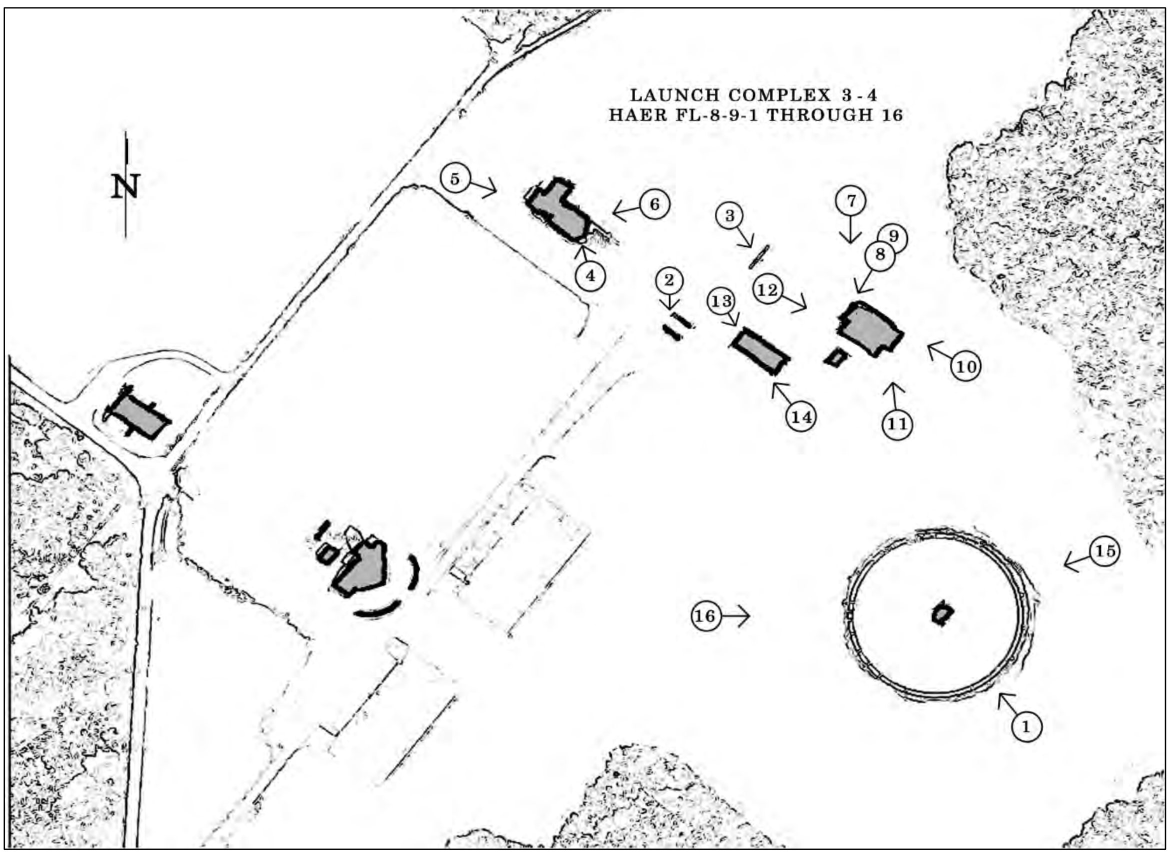
HAER No. FL-8-9-C

Northern terminus of Bumper Road (Lighthouse Road)
Cape Canaveral
Brevard County
Florida

INDEX TO BLACK AND WHITE PHOTOGRAPHS

Photographer: Martin Stupich, 2014
See photo key on page 2 of Index to Photographs

FL-8-9-C-1	GENERAL VIEW, POL BUILDING (No. 2842) ON RIGHT WITH BOMARC LAUNCHING BUILDING (No. 2841) ON LEFT; VIEW TO EAST (on photo key as #12)



Photograph Key for Entire Complex.

HISTORIC AMERICAN ENGINEERING RECORD
CAPE CANAVERAL AIR FORCE STATION
LAUNCH COMPLEX 3 AND 4
SEE INDEX TO PHOTOGRAPHS FOR CAPTION
HAER No. FL-8-9-C-1

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CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 3/4, FACILITY No. 2805 — HAER No. FL-8-9-D

(LAUNCH COMPLEX 3/4, HIGH PRESSURE AIR BUILDING)
Northern terminus of Bumper Road (Lighthouse Road)
Cape Canaveral
Brevard County
Florida

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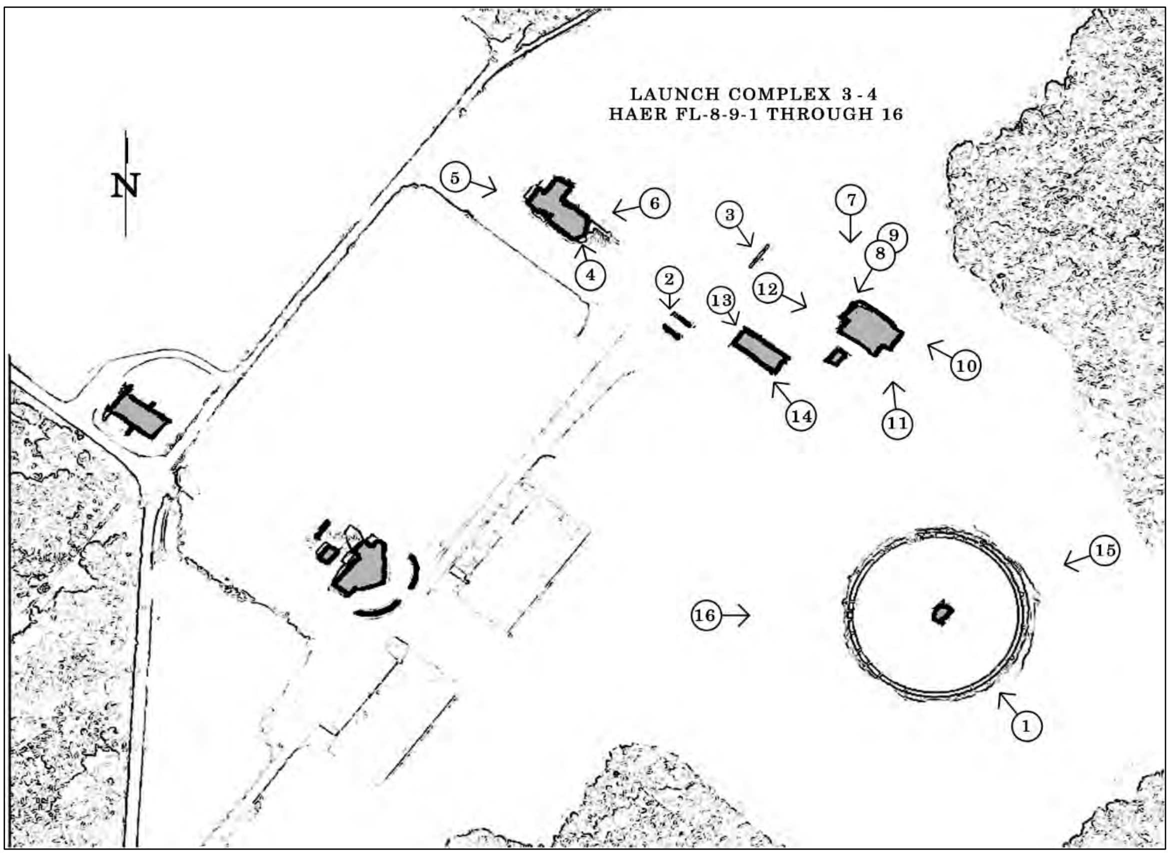
Photographer: Martin Stupich, 2014
See photo key on page 2 of Index to Photographs

FL-8-9-D-1	HIGH PRESSURE AIR BUILDING (No. 2805), NORTHEAST AND NORTHWEST FACADES; GENERAL VIEW NORTH TO SOUTH (on photo key as #13)
FL-8-9-D-2	HIGH PRESSURE AIR BUILDING (No. 2805), SOUTHWEST AND SOUTHEAST FACADES, WITH REMNANTS OF ELECTRIC SUBSTATION (No. 2810) TO LEFT; GENERAL VIEW SOUTH TO NORTH (on photo key as #14)



Photograph Key for Entire Complex.

HISTORIC AMERICAN ENGINEERING RECORD
CAPE CANAVERAL AIR FORCE STATION
LAUNCH COMPLEX 3 AND 4
SEE INDEX TO PHOTOGRAPHS FOR CAPTION
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HISTORIC AMERICAN ENGINEERING RECORD
CAPE CANAVERAL AIR FORCE STATION
LAUNCH COMPLEX 3 AND 4
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HAER No. FL-8-9-D-2

HISTORIC AMERICAN ENGINEERING RECORD

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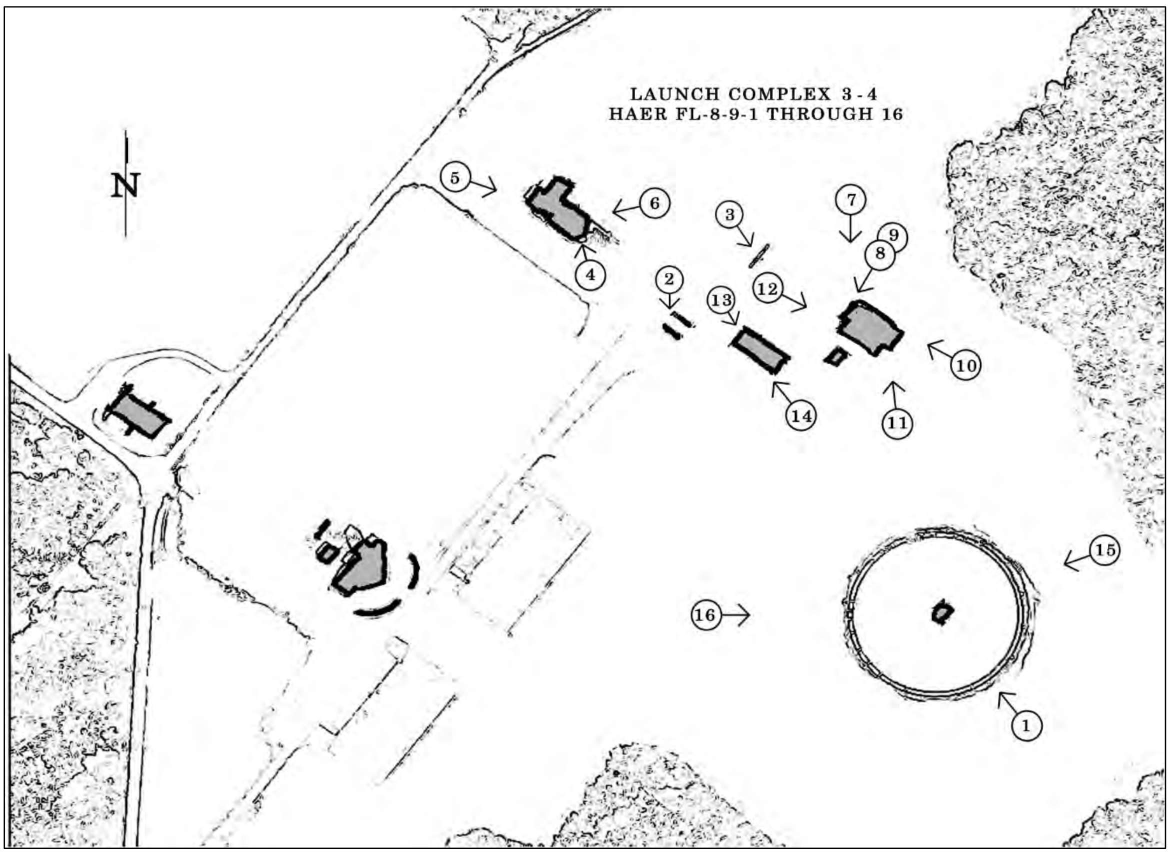
CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 3/4, FACILITY No. 2826 — HAER No. FL-8-9-E
(LAUNCH COMPLEX 3/4, GROUND SUPPORT BUILDING)
Northern terminus of Bumper Road (Lighthouse Road)
Cape Canaveral
Brevard County
Florida

INDEX TO BLACK AND WHITE PHOTOGRAPHS

Photographer: Martin Stupich, 2014
See photo key on page 2 of Index to Photographs

FL-8-9-E-1	GROUND SUPPORT BUILDING (No. 2826) AT CENTER OF TETHER BALLOON FACILITY SITE; VIEW TO SOUTHWEST (on photo key as #15)
FL-8-9-E-2	GROUND SUPPORT BUILDING (No. 2826), WEST TO EAST (on photo key as #16)



Photograph Key for Entire Complex.

HISTORIC AMERICAN ENGINEERING RECORD
CAPE CANAVERAL AIR FORCE STATION
LAUNCH COMPLEX 3 AND 4
SEE INDEX TO PHOTOGRAPHS FOR CAPTION
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LAUNCH COMPLEX 3 AND 4
SEE INDEX TO PHOTOGRAPHS FOR CAPTION
HAER No. FL-8-9-E-2

CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 9/10 HAER No. FL-8-10

North Side of Lighthouse Road, 0.9 miles north of Pier Road intersection
Cape Canaveral
Brevard County
Florida

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
Southeast Regional Office
National Park Service
U.S. Department of the Interior
100 Alabama Street, S.W.
Atlanta, GA 30303

HISTORIC AMERICAN ENGINEERING RECORD

CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 9/10

HAER No. FL-8-10

Location:	North side of Lighthouse Road, 0.9 miles north of Pier Road intersection Cape Canaveral Brevard County Florida USGS Cape Canaveral Quadrangle, Universal Transverse Mercator Coordinates: 17.543262.3147519
Date of Construction:	1953-1957
Engineer/Architect:	Steward and Skinner and Maurice H. Connell & Associates, Inc. and the United States Army Corps of Engineers
Present Owner:	United States Air Force
Present Use:	Vacant
Significance:	Constructed between 1953 and 1957, Launch Complex 9/10 at Cape Canaveral Air Force Station was designed to support the Air Force's Navaho winged intercontinental missile program. Although the Navaho program was cancelled soon after completion of the complex, test flights continued until November 1958. Launch Pad 10 served as the site testing location for the Navaho, the Jason research rocket, and the Alpha Draco missile. Following the deactivation of the complex in 1959, most of the facilities were reused when Launch Complex 31/32 was constructed for the Minuteman missile program on the same site. Launch Complex 9/10 played a vital role in the missile research and development program because technology utilized in the Navaho, Jason, and Alpha Draco was later adapted for use in the Atlas, Redstone, Jupiter, and Thor missiles, all vitally important to both national defense and future space flight.
Report Prepared by:	Kimberly Hinder Architectural Historian, Archaeological Consultants, Inc. 8110 Blaikie Court, Suite A, Sarasota, Florida 34240 Updated – Dr. Susan Enscore U.S. Army Engineer Research and Development Center Construction Engineering Research Laboratory 2902 Newmark Drive, Champaign, IL 61822
Date:	June 2003 (updated by Dr. Enscore February 2016)

HISTORICAL OVERVIEW OF CAPE CANAVERAL AIR FORCE STATION

Rocketry in the United States originated with the pioneering work of Robert H. Goddard, who launched the first liquid-propelled rocket in 1926. Across the Atlantic, German engineers were simultaneously developing their own rocket science program. Encouraged by the Nazi regime during World War II, the Germans developed the V-1 “buzz bomb” and the V-2 ballistic missiles which they used against Allied cities in 1944. Although the Allied forces had experimented with missiles powered by rocket engines, they lacked the technology to compete with the V-2 against which there was little defense. As a result, the U.S. Army, Navy, and Air Force each initiated their own missile programs to fulfill their particular roles in national defense.

Following the war, the U.S. Army brought 115 German rocket engineers and scientists, including Dr. Wernher von Braun, to the United States to develop their program. These engineers conducted experiments to refine the German V-2 and develop long-range surface-to-surface guided missiles. Initially stationed at Fort Bliss, Texas, the team assisted the Army in testing rockets at the White Sands Proving Grounds beginning in May 1946. This site, however, was geographically constrained and posed a danger to civilians when rockets misfired.[1]

Increasingly concerned with Soviet missile and nuclear development after World War II, the Department of Defense created and charged the Committee on Long Range Proving Grounds to select a suitable missile test site in October 1946. Cape Canaveral was selected for several critical reasons. Missiles could be launched over the Atlantic Ocean and tracked from islands. The isolated location of the Cape enhanced security for research and development. The government already owned land at the Cape, and the undeveloped nature of the remaining land made it less expensive to acquire. The launch area was accessible via water easing the transportation logistics of heavy rockets and building supplies. The warm weather also allowed year-round operation of a missile site at the Cape.[2]

In 1949, President Harry S. Truman signed legislation which established the Joint Long Range Proving Ground at Cape Canaveral, with Patrick Air Force Base (originally the Banana River Naval Air Station) selected as the support base. Although the entire facility was initially under

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[1] Charles D. Benson and William B. Faherty, *Moonport: A History of Apollo Launch Facilities and Operations* (National Aeronautics and Space Administration, Scientific and Technical Information Office, 1978; reprint as *Gateway to the Moon: Building the Kennedy Space Center Launch Complex* and *Moon Launch! A History of the Saturn-Apollo Launch Operations*, Gainesville: University Press of Florida, 2001), 1 (page references are to reprint edition).

[2] David Barton and Richard S. Levy, *An Architectural and Engineering Survey and Evaluation of Facilities at Cape Canaveral Air Force Station, Brevard County, Florida* (Resource Analysts, Inc., 16 March 1984), 3-4; Benson and Faherty, 4.

the cooperative use of the Army, Navy, and Air Force, the Air Force, by a directive of the Department of Defense, ultimately assumed responsibility for the range. The Joint Long Range Proving Ground was renamed the Air Force Missile Test Center, the first of many subsequent name changes. Although the Army continued its operation of the White Sands Proving Grounds in New Mexico and the Navy continued to fund its missile testing center at Point Mugu, California, both military branches continued to play an active role at Cape Canaveral.[3]

Construction and Missile Development at Cape Canaveral

Between April and June of 1950, land was acquired at the Cape through negotiation and condemnation proceedings. During this period, the United States Army Corps of Engineers was designated as the construction agency. The Jacksonville District of the Corps opened an office at Patrick Air Force Base in 1950 to oversee construction at Patrick Air Force Base and the Air Force Missile Test Center at Cape Canaveral. By December 1950, the office had managed $2.4 million of construction contracts. For each construction project, the agency (Army, Navy, Air Force) would submit project specifications, a deadline for completion, and authorization to begin construction to the Corps. The Corps would then negotiate and award a contract to an architectural/engineering firm for preparation of the construction plans. Once the plans were submitted, the Corps advertised and selected a contractor who was required to complete the project within the time frame or pay penalties.[4]

As the United States entered peacetime and reduced military funding during the late 1940s, the various branches of the military sought to determine their roles in missile research and design. The Army continued refining the German V-2, with the assistance of the team led by Wernher von Braun and 300 carloads of V-2 missile components seized during World War II. The Army conducted the first successful launch at Cape Canaveral on July 24, 1950. An Army-General Electric Corporation-California Institute of Technology team launched Bumper No. 8, a modified V-2 rocket, from Launch Pad 3. The Army team continued to use Pad 3 to conduct additional launches through 1951.[5]

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[3] E.R. Bramlitt, *History of Canaveral District 1950–1971*, (South Atlantic Division, U.S. Army Corps of Engineers, 1971), 1–2; Benson & Faherty, 3, 7.

[4] Bramlitt, 1-2, 33.

[5] Benson & Faherty, 1, 6–7.

During the late 1940s and early 1950s, Air Force activities at Cape Canaveral focused on winged cruise missile research and development as a deterrent force in the weapons race between the United States and the Soviet Union. Constrained by a reduced budget, the Air Force chose to fund research and testing on the cruise missile, projected to be operational before the ten years anticipated for the development of the ballistic missile. These winged missiles resembled unmanned airplanes and fell into four different categories: air-to-air, air-to-surface, surface-to-air, and surface-to-surface. These missiles were restricted to the Earth's atmosphere because they required oxygen for engine combustion. The earliest launch pads, used for firing experimental winged missiles including the Lark, Matador, Snark, Bomarc, Bull Goose, and Mace, were located at the tip of the Cape, and included Launch Complexes 1 & 2, 3 & 4, 9 & 10, and 21 & 22. Support buildings, including a communications building, a water plant, a fire fighting unit, electrical substations, a skid strip for the landing and reuse of the missiles, and Hangars C and O, were constructed near the original launch pads. As explosive power increased, and missiles necessarily grew larger, support activities were relocated farther from the launch pads to an Industrial Area which was situated along the western shore of the Cape.[6]

After the Soviets detonated their first atomic device in 1949, and following the outbreak of war in Korea in 1950, the United States government reassessed the military cutbacks of the late 1940s. With increased funding and the development of relatively lightweight nuclear warheads, the Air Force and Army decided to pursue ballistic missile research and development. Faster and more accurate than the winged cruise missiles, ballistic missiles, with their own oxygen source, could leave the Earth's atmosphere. The ballistic missiles were divided into two categories based on the distance they could travel. The intercontinental ballistic missiles (ICBM) had a range of over 5,000 miles. Intermediate range ballistic missiles (IRBM) had a range of 1,500 miles. The Air Force, which remained focused primarily on the development of cruise missiles, initiated a ballistic missile study which resulted in the Atlas missile.[7]

To advance its research and development of ballistic missiles, the Army Ballistic Missile Agency moved their team of German engineers from Fort Bliss, Texas, to the Redstone Arsenal in Huntsville, Alabama. Soon after the move to Huntsville, the launch team, known as the Missile Firing Laboratory (MFL), established facilities at Cape Canaveral. With the first launch of the Redstone missile on August 20, 1953 at Launch Pad 4, the MFL inaugurated the testing of

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[6] Barton and Levy, 6, 25; Bramlitt, 5-8; Jacob Neufeld, *The Development of Ballistic Missiles in the United States Air Force, 1945–1960*, (Washington, D.C.: Office of Air Force History, United States Air Force, 1990), 239.

[7] Neufeld, 98, 241; Benson and Faherty, 1, 3, 7.

ballistic missiles, an event which foreshadowed the construction of numerous launch facilities for ballistic missiles at the Cape.[8]

Both the detonation of the first thermonuclear device in 1952 and intelligence reports indicating that the Soviet Union was developing long-range missiles and thermonuclear warheads led to advancements in ballistic missile development. In 1953, the Air Force formed a panel of U.S. scientists to examine their Snark, Navaho, and Atlas missile programs. The panel recommended accelerating development of the Atlas ICBM.[9] By 1955, Air Force officials convinced President Eisenhower to assign the ICBM development program the highest national priority. Accordingly, the Air Force initiated programs for the design and testing of the ICBM Titan in 1955 and the ICBM Minuteman in 1958. As the Air Force ICBM program grew, intelligence reports indicated that the Soviet Union would have ICBMs with nuclear warheads operational by 1960. Fearing that the United States could not match the Soviet ICBM threat, the Department of Defense decided to fund the development of IRBMs because they would be operational sooner and would act as a deterrent based out of Europe. In 1955, the Department of Defense approved two IRBM programs, the Air Force Thor and the Army/Navy Jupiter, which developed simultaneously and were assigned an equal national priority as the ICBM programs.[10]

The constant drive to develop more accurate and powerful weapons during the Cold War led to the construction of numerous launch complexes along the Cape. Although many of the early launch complexes were adapted to new uses as support structures, complexes constructed for one type of missile were rarely reused to launch another type of missile because they were not configured structurally, electronically, or for safety concerns for the new larger and more powerful missile. Economically, it was more cost effective to design and build a new complex than to reconfigure and adapt an old complex. Explosive hazards, the dangers of launching over other complexes or inhabited areas, and maintaining a line of site between the launch vehicle and the launch control center (blockhouse) determined the choice of sites and distance between launch complexes. Each missile had similar ground requirements at the launch complex including a launch pad, a gantry service tower, a blockhouse for on-site command and control of

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[8] Benson and Faherty, 1, 3, 7.

[9] Neufeld, 98-103; David N. Spires, “The Air Force and Military Space Missions: The Critical Years, 1957-1961,” in *The U.S. Air Force in Space: 1945 to the 21st Century*, Proceedings Air Force Historical Foundation Symposium, Andrews AFB, Maryland, September 21-22, 1995, ed. R. Cargill Hall and Jacob Neufeld (Washington, DC: USAF History and Museums Program, United States Air Force, 1998), 34–35.

[10] ibid., 143-48, 241–242.

the launch, and a network of power, fuel, and communication links.[11] The government maintained programs for both ICBMs and IRBMs concurrently and facilities for both types of missiles were constructed at Cape Canaveral. Over time, the area south of the tip was developed for launching IRBMs (Redstone, Pershing, Polaris/Poseidon, and Thor) and included launch complexes 5 & 6, 17, 18, 25, 26, 29, and 30). The area north of the tip was developed for launching ICBMs and space launch vehicles (Atlas, Titan, Saturn) and included complexes 11, 12, 13, 14, 15, 16, 19, 20, 34, 36, and 37.[12]

Throughout the early and mid-1950s, the focus of activities at Cape Canaveral remained on missile development for defense against the Soviets. In November 1956, the Secretary of Defense divided the responsibilities for research and development of missiles among the armed forces. The Air Force received responsibility for all intermediate and long-range missiles, both IRBMs and ICBMs, while the Army was restricted to missiles with a range of 200 miles or less. The Navy was limited to developing submarine and ship-based IRBM missile systems.[13]

Cape Canaveral and the United States Space Program

In 1955, President Eisenhower announced that the United States would launch an unmanned satellite as part of the nation's participation in the International Geophysical Year which extended from July 1957 through December 1958. The Army, Navy, and Air Force immediately initiated planning for their own satellite programs.[14] When the Soviets launched the satellite Sputnik I in October of 1957, the attention of the public turned to space exploration. The following month, the Soviets placed the Sputnik II satellite carrying a dog into orbit around the Earth. The launch caused a furor among Americans who feared that the U.S. was losing not only the "space race," but also that a "missile gap" existed between the U.S. and the Soviets, who it was believed had hundreds of operational ICBMs. The President initially assigned responsibility for the U.S. space program to the Department of Defense. The Army's Development Operations Division led by

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[11] Benson and Faherty, 8-10.

[12] Barton and Levy, 4, 9; Denise P. Messick, Cynthia G. Rhodes, and Charles E. Cantley, *45th Space Wing Cultural Resource Management Plan*, Technical Report No. 386 (Stone Mountain, Georgia: New South Associates, 1996), 95; James N. Gibson, *Nuclear Weapons of the United States: An Illustrated History* (Atglen, PA: Schiffer Publishing, Ltd., 2000); Hartmann 2003.

[13] Neufeld, 242; Barton and Levy, 17.

[14] R. Cargill Hall, "Civil-Military Relations in America's Early Space Program," in *The U.S. Air Force in Space: 1945 to the 21st Century*, Proceedings Air Force Historical Foundation Symposium, Andrews AFB, Maryland, September 21-22, 1995, ed. R. Cargill Hall and Jacob Neufeld (Washington, DC: USAF History and Museums Program, United States Air Force, 1998), 25.

Wernher von Braun shifted their focus to the use of missiles to propel payloads, or even a man, into space.[15] After several failures on the launch pad, the United States entered the space race with the launch of the Army's scientific satellite Explorer I on January 31, 1958, using a four-stage Jupiter C missile named Juno I. With the threat of a growing fleet of operational Soviet ICBMs, the branches of the U.S. military initiated the development of photographic reconnaissance satellites which were operational by 1960.[16]

Realizing that the military's involvement in the space program would jeopardize the goal of using space for peaceful purposes, the President's Science Advisory Committee urged that a centralized agency be created to oversee the scientific exploration of space. The new agency, the National Aeronautics and Space Administration (NASA), established October 1, 1958, was to be a civilian agency with the mission of carrying out scientific aeronautical and space exploration, both manned and unmanned. The Department of Defense, especially the Air Force, would continue with defense related missile and satellite development.[17] Soon after the creation of NASA, Navy personnel and facilities associated with Project Vanguard and over 400 scientists from the Naval Research Laboratory were reassigned to NASA. The California Institute of Technology's Jet Propulsion Laboratory, affiliated with the Army, was also transferred to NASA. Initially working with NASA as part of a cooperative agreement, President Eisenhower officially transferred a large portion of the Army's Development Operations Division with the team led by Wernher von Braun to NASA in March 1960. At the same time, Eisenhower named the Huntsville NASA installation the Marshall Space Flight Center, and designated the MFL at Cape Canaveral as the Launch Operations Directorate of NASA. The Launch Operations Directorate, led by Dr. Kurt Debus, managed the overall integration, testing, and the launch operations of NASA.[18]

NASA soon organized a National Launch Vehicle Program to identify and analyze which missiles would be the most effective in exploring space. As a result, the Scout, Thor (Delta), Atlas, Titan, and Saturn, and modified versions of these rockets, were selected as boosters for manned and unmanned missions. Unmanned activities have included suborbital, orbital, and lunar satellite and vehicular missions to gather scientific information often relating to physics and astronomy. Although some were conducted to prepare for manned launches, most of the

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[15] Benson and Faherty, 1-2.

[16] ibid.

[17] Hall, 30; Barton and Levy, 20; Spires, 39.

[18] Spires, 39; Benson and Faherty, 15.

missions were intended simply to gain scientific knowledge with which to better understand Earth.[19]

Already upstaged by the Soviets, one of NASA's first goals was to put a man in orbit around the Earth. At its creation, the Air Force's manned space projects were transferred to NASA, which NASA combined under the name Project Mercury in December 1958. NASA selected the first seven astronauts for the manned space program in April 1959. The goals of Project Mercury included sending a man into space to orbit the Earth, testing his ability to perform in a weightless environment, and to recover both man and capsule.[20] The program included two manned suborbital flights powered by a modified Redstone missile and four manned orbital flights powered by an Atlas missile topped by the Mercury capsule. The first suborbital flight occurred on January 31, 1961 with the launch of Ham, a chimpanzee. The United States was again upstaged when the Soviet Union launched Vostock I with cosmonaut Uri Gagarin to orbit the Earth in April 1961. The launch of Alan Shepard the following month on a Mercury suborbital flight proved anticlimactic.[21]

Realizing the impact of the Soviet advancements on the American psyche, President John F. Kennedy appointed Vice President Lyndon Johnson, in cooperation with representatives from NASA and the associated industries, to develop a space program that would surpass the Soviet program. The panel recommended a ten-year phased approach which would include manned space flight, planetary exploration, and the development of new rockets and satellites. Accepting the recommendations, President Kennedy presented the following before a joint session of Congress on May 25, 1961:

> I believe this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the Moon and returning him safely to the Earth. No single space project in this period will be more impressive to mankind, or more important for the long-range exploration of space, and none will be so difficult or expensive to accomplish.[22]

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[19] Barton and Levy, 20–27.

[20] Spires, 39; *Exploring Space...Project Mercury* (U.S. National Aeronautics and Space Administration), Kennedy Space Center Archives, Kennedy Space Center, Sweetsir Collection 95-15, Box 12, 3.

[21] Harry Butowsky, "Man in Space (Reconnaissance Survey) 1903–1981," (Denver: National Park Service, 1981), 4.

[22] ibid., 4–5.

With widespread support, the public and Congress embraced the goal and the program proceeded rapidly. Circling the Earth three times, John Glenn completed the first manned orbital flight of the United States on February 20, 1962 in a capsule propelled by an Atlas rocket from Launch Complex 14. Followed by three more manned orbital flights, the Mercury program concluded as a success on May 15, 1963.[23]

NASA initiated planning for Project Gemini in late 1961 as the intermediate step in sending a man to the moon. Officially announced in 1962, the project was operational by 1964. The goals of Project Gemini included testing man's performance during extended periods in space, both within and outside of the spacecraft, development of rendezvous and docking techniques, and perfection of controlled reentry and landing techniques. The larger, more maneuverable capsule, designed to hold two men, was propelled by a Titan II rocket. Following the first unmanned Gemini launch on April 8, 1964, Gemini 3 was the first manned flight of the program in March 1965. Gemini 12, launched in November 1966, successfully completed the program.[24]

Apollo, the final step in landing astronauts on the moon, immediately followed Project Gemini. Studies to build the Saturn rocket, which would propel man to the moon, actually started in 1957 with the team led by Wernher von Braun under the Army's jurisdiction.[25] Ten times more powerful than the Atlas rocket and twenty times more powerful than the Jupiter, the size and power of the Saturn required the construction of Launch Complexes 34 and 37 at Cape Canaveral. Test flights of the Saturn rocket started at Launch Complex 34 in October 1961. In January 1962, NASA announced that the Saturn would be the moon launch vehicle. The goal of Apollo was to launch a team of three astronauts into orbit around the moon. While one astronaut remained in orbit, the other two would then take an attached spacecraft to land on the moon and then redock with the primary vessel before returning to Earth. The initial missions were Earth orbital (unmanned and manned) followed by lunar missions to orbit and, later, land on the moon.[26]

NASA utilized Launch Complexes 34 and 37 for research and development of the Saturn rocket. Continued modifications to the Saturn to increase its power to propel man to the moon led to a

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[23] Barton and Levy, 28.

[24] Ibid., 28-30; William A. Lockyer, Jr., *A Summary of Major NASA Launchings: October 1, 1958-September 30, 1973,* KSC Historical Report No. 1 (John F. Kennedy Space Center: KSC Historical Services, 1973), IX-1-8.

[25] Benson and Faherty, 1–2.

[26] ibid., 37, 60–64; Barton and Levy, 30–31.

larger rocket with new blast and acoustic hazards. With these factors in mind, combined with the stepped-up launch schedule necessary to land a man on the moon by the end of the decade, it was apparent by 1961 that the Apollo program required a new launch complex.[27] Cape Canaveral, with over 22 launch complexes, did not have room for another complex. NASA officials solved the dilemma by acquiring land on Merritt Island, west and north of the existing missile launching area at the Cape. The first acquisitions of land started in 1962, with the majority under federal ownership by 1964. Initially known as the Merritt Island Launch Area, the land was acquired for use predominantly in support of the Manned Lunar Landing Program (Apollo) and was placed under NASA's exclusive jurisdiction. With the new facilities, NASA's offices at the Cape, led by Kurt Debus, expanded and relocated to the Merritt Island Launch Area. The newly independent installation, on par with Marshall Space Flight Center, was renamed the John F. Kennedy Space Center in November 1963 after the death of the president.[28]

During land acquisition and construction of the Kennedy Space Center, NASA continued manned space flight under the Mercury and Gemini programs and preparations for Apollo. During a simulation flight at Launch Complex 34, three astronauts, Virgil Grissom, Edward White, and Roger Chaffee, lost their lives in an oxygen fire in the cockpit on January 27, 1967, an event later commemorated as Apollo 1. Apollo 4 (November 9, 1967) through Apollo 6 (April 4, 1968) were unmanned Earth orbital missions to test the Saturn rocket and the Command and Service modules. The October 11, 1968 Apollo 7 launch was the first manned Apollo launch which placed astronauts into Earth's orbit for a ten-day mission. Apollo 8, the first launch at the newly completed Kennedy Space Center, achieved the first lunar orbit in December 1968. The goal of landing man on the moon was achieved with Apollo 11 on July 20, 1969 and was followed by six additional lunar missions which gathered extensive scientific information culminating in Apollo 17 in December 1972. Subsequent manned space programs included the Skylab, Apollo-Soyuz, and the Space Shuttle, which took its inaugural flight on April 12, 1981. The Space Shuttle program ended on July 21, 2011.[29]

History of Complex 9/10

As one of the first launch complexes constructed at Cape Canaveral, Launch Complex 9/10 played a significant role in the future development of the Cape and the Cold War (Figure 1). The

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[27] Benson and Faherty, 65–68.

[28] ibid., 96–98, 105, 133–137, 146–48.

[29] Barton and Levy, 31; Butowsky "Man in Space," 5–6.

arms race between the United States and the Soviet Union to develop more powerful and accurate weapons was a defining feature of the Cold War. Technology utilized in the Navaho, Jason, and Alpha Draco programs was adapted for use in the Atlas, Redstone, Jupiter, and Thor missiles necessary to both national defense and future space flight. The missile research and development program, in which Launch Complex 9/10 played a vital part, provided the United States with an operational, conventional, and nuclear missile force for defense in the arms race. As a military facility, the complex was deactivated and replaced by Launch Complex 31/32 in order to support operational and programmatic changes.

Launch Complex 9/10 was constructed to support the Navaho winged surface-to-surface cruise missile program. As the United States entered peacetime and reduced military spending during the post-World War II era, the Air Force chose to fund research and testing on the cruise missile, projected to be operational before the ten years anticipated for the development of an operational ballistic missile.[30] As part of this effort, the Air Force initiated a program in 1947 to develop an unmanned winged cruise missile which could fly 5,500 miles, the most advanced aircraft under design at the time. In 1952, North American Aviation received the contract for the production and testing of this missile, named the Navaho.[31]

Following the detonation of the first Soviet atomic device in 1949 and the outbreak of war in Korea in 1950, the United States government reassessed the military cutbacks of the late 1940s. With increased funding, the Air Force decided to again pursue ballistic missile research and development. Although the Air Force authorized the continued development of the ICBM, funding remained at lower levels than for the Snark and Navaho missile programs.[32]

Both the detonation of the first thermonuclear device in 1952 and intelligence reports indicating that the Soviet Union was developing long-range missiles and thermonuclear warheads led to advancements in missile development. Designated the Navaho X-10, the initial version of the missile was designed to test the missile's canard aerodynamics, flight control system, inertial guidance, advanced honeycomb structure, and new materials and equipment. Launched like a conventional aircraft, the recoverable X-10 had retractable landing gear utilized to return to the

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[30] Neufeld, *Development of Ballistic Missile*, 239.

[31] Clifford J. Lethbridge, "Navaho Fact Sheet," Spaceline.org, Spaceline, Inc., 1998.

[32] Neufeld, *Development of Ballistic Missile*, 239.

Cape after completing their test flights. Between August 1955 and January 1959, fifteen Navaho X-10 missiles were launched from the Cape Canaveral Skid Strip.[33]

The production version of the Navaho, the XSM-64, was comparable to an actual bomber with a maximum altitude of 60,000 feet and a flight speed of 2,150 m.p.h. Heavier than the heaviest airliners flying at the time, the missile was launched at a 90-degree angle attached to a cylindrical booster. Three engines at the base of the booster were powered by liquid fuel composed of liquid oxygen and RP-1 (kerosene) which produced a combined 450,000-pound thrust at launch. After the vertical climb, the Navaho arched toward its trajectory. As the vehicle and booster package separated, twin on-board ramjets ignited, powering the missile toward its target. The Navaho XSM-64 also incorporated retractable landing gear to return to the Cape.[34]

In October 1953, the Air Force formed a panel of U.S. scientists to examine their Snark, Navaho, and Atlas missile programs. The panel, officially known as the Strategic Missiles Evaluation Group and unofficially as the Teapot Committee, recommended maintaining the Snark and Navaho programs, but accelerating development of the Atlas ICBM.[35] With the support of the committee, North American Aviation continued development of the Navaho, and the Air Force initiated the construction of a complex designed to launch it.

Built to launch the Navaho XSM-64, the U.S. Army Corps of Engineers initiated construction of Launch Complex 9/10 in September 1953. Initial construction efforts focused on the Blockhouse and Launch Pad 9. As the first scheduled launch grew closer, the Air Force permitted North American Aviation engineers conditional occupancy of the Blockhouse and Launch Pad 9 in January 1955, although construction was not yet completed. Officially, the structures were completed late in 1955, and received final acceptance from the Corps in June 1956. Launch Pad 9 consisted of a raised concrete pedestal with a fold-away erector gantry, known as the Taj Mahal by Navaho engineers, which raised the missile into launch position from the top deck of the structure (Figure 2). Checkout of Launch Pad 9 and the Blockhouse was completed with four

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33 Lethbridge, “Navaho Fact Sheet,” 1998; Lethbridge, “Cape Canaveral Rocket and Missile Box Scores,” 2001.
34 Lethbridge, “Navaho Fact Sheet,” 1998.
35 Neufeld, 98-103; Spires, 34-35.

successful static firings of a prototype booster in December 1955 and January 1956. The first Navaho XSM-64 launch occurred from Launch Pad 9 on November 6, 1956.[36]

Construction of Launch Pad 10 started in 1955 and reached "beneficial occupancy" status in September 1956. Launch Pad 10 consisted of a reinforced concrete pad upon which the missile would be launched from a mobile Navaho launch stand (Figure 3). Handwritten notations on property cards kept by the Air Force indicate that a July 1957 "report to the management" stated that "no further action will be taken on the completion of Pad 10." Early in 1957, the Air Force had placed a hold on advertising for the construction of future Navaho facilities. Despite this action, Launch Pad 10 appeared ready for use.[37]

Launch Pad 10 was initially utilized for the static firing of a Navaho booster in February 1957. This was the first use of the mobile launcher unit developed for Navaho by the Food Machinery Corporation. Although the static tests were successful, photographs show that the missile was launched from the pedestal at Launch Pad 9 in March 1957 in order to minimize the potential for failure. Scholars who have studied the Navaho program debate whether any Navaho missiles were actually launched from Launch Pad 10. Photographs indicate that Navaho missiles were erected on the mobile launcher on Pad 10, and definitely underwent static test firing. Photographs and motion pictures of the launches attributed to Pad 10 indicate that several of the missiles were launched from the Pedestal at Pad 9.[38] However, James N. Gibson, author of *The Navaho Missile Project: The Story of the "Know-How" Missile of American Rocketry*" and whose father worked in the Navaho Program, states that the fifth Navaho XSM-64 flight was launched from the mobile launcher on Launch Pad 10 on August 12, 1957. Another Navaho missile may have been launched from Pad 10 on January 10, 1958.[39]

As construction of the complex and development of the Navaho missile continued, intelligence reports indicated that the Soviet Union would have ICBMs with nuclear warheads operational by

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[36] Joel W. Powell, "Uncovering Old Pad 10: The Search for the Draco Launch Site at Cape Canaveral," *Spaceflight* 44 (June 2002): 256; Gibson, *The Navaho Missile Project*, 51, 57, 63; "Eastern Test Range Launch Complexes"; Cleary, Eastern Range Launches; Real Property Cards, Cape Canaveral Air Force Station, 45th Space Wing Office of History, Patrick AFB; Cleary, "Launch Facilities & Programs: Complexes 9/10".

[37] Real Property Cards, Cape Canaveral Air Force Station, 45th Space Wing Office of History, Patrick AFB; Cleary, "Launch Facilities & Programs: Complexes 9/10"; Gibson, *The Navaho Missile Project*, 67.

[38] Powell, 256; Gibson, *The Navaho Missile Project*, 68.

[39] James N. Gibson, *The Navaho Missile Project: The Story of the "Know-How" Missile of American Rocketry* (Atglen, PA: Schiffer Publishing Ltd., 1996), 72–73; Cleary, Eastern Range Launches.

1960. By 1955, Air Force officials convinced President Eisenhower to assign the ICBM development program the highest national priority. Fearing that the United States could not match the Soviet ICBM threat, the Department of Defense decided to fund the development of IRBMs because they would be operational sooner and would act as a deterrent based out of Europe. The Eisenhower Administration reduced funding for missile development in 1956 and planned further cuts for fiscal year 1958, when the Soviets launched Sputnik I in October of 1957. Public outcry of a “missile gap” between the Soviets and the United States prompted the Administration to reverse its budget cuts and again accelerate the ICBM and IRBM programs.[40] The growth of these ballistic missile programs made the Navaho obsolete. This, combined with the reduction in funding for missile development in 1956, led to the cancellation of the Navaho program in July 1957.[41]

Despite the cancellation, Air Force officials permitted the launch of five of the remaining Navaho missiles in order to gather additional data on the high temperature environment encountered at the higher speeds.[42] Nine Navaho XSM-64 missiles were tested and launched from Launch Complex 9/10 between November 1956 and February 1958. Although useful data was gathered leading to the overall success of the program, many of these launches were delayed or failed due to technical problems.[43] One such failure, the third launch of the Navaho XSM-64 from the Pedestal at Launch Pad 9, damaged the launch facilities. During the April 25, 1957 launch, engine ignition was normal, and the vehicle lifted approximately 4' above the Pedestal. However, the control lanyard cable did not release prompting the booster engines to shut down. Although the vehicle initially settled back onto the Pedestal, it soon fell backwards off of the Pedestal and exploded, destroying itself and damaging the Pedestal. The complex underwent repairs until mid-June. This launch failure also appears to have led to the redesign of the Blockhouse to further insulate it against the possibility of future missile failure. By April 1957, the program had attempted fifteen Navaho launches, of which only two left the base area. This, combined with the failure of the third launch, prompted the incorporation of improvements to both the Navaho missile and to ground equipment.[44]

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[40] Neufeld, 143-48, 241-242.

[41] Gibson, *The Navaho Missile Project*, 71; Lethbridge, “Navaho Fact Sheet,” 1998.

[42] Gibson, *The Navaho Missile Project*, 71.

[43] ibid., 66-77.

[44] Gibson, *The Navaho Missile Project*, 69-70.

The final two Navaho launches, on September 11, 1958 and November 18, 1958, were associated with Project RISE (Figure 4). Project RISE (Research in Supersonic Environment) was initiated after the cancellation of Navaho in order to study supersonic aerodynamics. The Air Force planned to utilize the remaining seven Navaho missiles. Although the launches in September and November 1958 were successful and the Air Force did gather information from the experiment, the missiles later failed down range. This led to the cancellation of all future RISE launches utilizing the Navaho. The project proved very successful at altitudes up to 18 miles and speeds over Mach 3. The project also included launches of the X-10 missile.[45] Although never operationally deployed, the Navaho was instrumental in future missile development and space missions. Technology utilized in the Navaho, including the pump-fed booster engines, cryogenic propellant, and inertial guidance systems, was adapted for use in the Atlas, Redstone, Jupiter, and Thor missiles which were vitally important to both national defense and future space flight.[46]

As the Navaho program was cancelled and the final flights were launched from the Pedestal at Pad 9, Launch Pad 10 was utilized by the Jason program (Figure 5). The Jason was a research rocket developed by the Air Force. Only six rockets were launched from Pad 10 during the short program, which lasted less than a month, from August 14 to September 2, 1958.[47]

Although Pad 9 was deactivated following the final Navaho launch in November 1958, Launch Pad 10 was reassigned to the Alpha Draco program. Part of a competition to develop a long-range, air-launched ballistic missile, McDonnell Aircraft designed the Alpha Draco, also known as the Model 122B Test Vehicle. As a research rocket designed to support Air Force high-altitude research activities, the Alpha Draco was a two-stage solid-fueled rocket which carried an aeroballistic nosecone payload (Figure 6). Alterations to the pad included the installation of a concrete flame deflector and tie-down points along the northwest perimeter. Launched from a mobile launcher, the first Alpha Draco launch occurred on February 16, 1959 followed by the second a month later on March 16, both from Launch Pad 10. Although launched like a ballistic missile, the first and second stage boosters would carry the payload to the designated altitude after which the payload would then glide toward its target without power. This boost-glide

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[45] Powell, 256; Mark Cleary, Eastern Range Launches, (45th Space Wing Office of History, Patrick AFB, 11 December 2002); Norman J. Bowman, *The Handbook of Rockets and Guided Missiles*, 2d ed. (Newtown Square, PA: Perastadion Press, 1963), 449; Gibson, *The Navaho Missile Project*, 77.

[46] Lethbridge, “Navaho Fact Sheet,” 1998.

[47] Lethbridge, “Cape Canaveral Rocket and Missile Box Scores,” 2001; communication with Hartmann 2003; Jason Research Rocket at Launch Pad 10 Photograph, University of Central Florida, Florida Space Coast History Project, scanned copy provided courtesy of Al Hartmann.

concept would allow the use of a heavier weapons payload than a ballistic missile. Although the program was short-lived with only three launches, it was successful and provided valuable information for the development of future missiles and space travel. In addition to successfully testing the boost-glide concept, the Alpha Draco supplied data on the aerodynamics of hypersonic flight and materials which could withstand high temperature levels. The final Alpha Draco launch, on April 27, 1959, concluded the program (Figure 7).[48]

Following the final Alpha Draco launch, the Air Force deactivated Launch Complex 9/10, but reused many of the facilities as part of Launch Complex 31/32. The new Minuteman missile complex was essentially built on top of the deactivated complex. Initiated in July 1959, Launch Complex 31/32 consisted of two flat concrete pads, Pads 31A and 32A, and two underground silo launch sites, Pads 31B and 32B, serviced by two new Blockhouses. Launch Pad 10 was converted to Launch Pad 31A, while the Pedestal at Launch Pad 9 was enclosed to create a storage building.[49] The Sentry Box and Pre-launch Shelter appear to have been removed. All of the remaining facilities were renamed and reused. The Air Conditioning Building was converted to a Locker and Tool Building. The Blockhouse changed to the Administration and Engineering Office Building. The Pump House and Reservoir was designated the Support Shop, and the Nitrogen Shed was renamed the Pad Service Building. The Pedestal was later abandoned in place in May 1971. A Maintenance Shop was constructed east of Launch Pad 9 in 1970. Following the conclusion of the Minuteman program in 1970 and the subsequent Pershing 1A launches from the site in 1973, several of the former Launch Complex 9/10 facilities were transferred to serve the 2nd Combat Communications Group. In 1978, the Pump House and Reservoir was transferred to serve as a training facility for the Group, while the Blockhouse was converted to house the Instructor's Quarters. The Nitrogen Shed was altered to serve as a Latrine. In 2000, both the Pump House and Reservoir and the Nitrogen Shed were reassigned as Museum Rocket Restoration Facilities. At the same time, the Blockhouse reverted to the designation as Navaho Blockhouse.

In 2004, a plan was developed to construct buildings at Complex 31/32 to provide a site for a Force Protection Training Area. The plan called for the refurbishment of Facilities 17768 (Support Shop) and 17756 (Launch Pad 9). Several new buildings were partially constructed on

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[48] Powell, 256–57; Mark Cleary, Eastern Range Launches; Clifford J. Lethbridge, "Alpha Draco Fact Sheet," Spaceline.org, Spaceline, Inc., 2000.

[49] United States Air Force, Property Cards 17780 and 17700, Launch Complex 9/10 files; Hartmann, 2003; Powell, 257.

Launch Complex 31/32.[50] At the Pedestal, three-rung steel railing was placed around the perimeter of the roof, and the existing railing along the stairs was replaced. A lightning protection system was installed on the roof with a ground rod at each corner, all connected with overhead ground wire.[51] New fencing was installed around the Support Shop, and some minor interior alterations were made.

The Nitrogen Shed was demolished in 2006 after suffering extensive damage in a hurricane. The majority of the facilities associated with Launch Complex 9/10 remain in place, but are vacant and in a deteriorated state.[52]

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[50] "Proposal to Construct a Force Protection Training Area at Former Launch Complex 31/32 on Cape Canaveral Air Force Station, Florida," (Patrick Air Force Base, Florida: 45th Space Wing, Environmental Flight, 2005), 1-3; "Real Property Accountable Record for Complex 31/32."

[51] Technical Engineering and Spacelift Services, "Construct Force Protection Training Area," Drawings DBEH No. 03-1584, U.S. Air Force, 45th Space Wing, 2004.

[52] United States Air Force, Property Cards 17706, 17780, 17766, 17767, and 17768, Launch Complex 9/10 files; United States Air Force, Voucher No. 62-1395, 63-1261, 72-1114, and 78-1113; United States Army Corps of Engineers, Drawing 201-24.426-1; Steward and Skinner and Maurice H. Connell & Associates, Inc., Drawing 201-23.768-67; Pan American World Airways, Inc., *Basic Information Guide*, 1960; Hartmann, 2003; Master Planning, *CCAFS Basic Information Guide*.

ARCHITECTURAL DESCRIPTION OF LAUNCH COMPLEX 9/10

Designed for the Air Force's Navaho winged intercontinental missile program, Launch Complex 9/10 was constructed between 1953 and 1957. The first Navaho launch occurred from Launch Pad 9 on November 6, 1956, followed by the first launch from Pad 10 in August 1957.[53] Launch Complex 9/10 was deactivated in 1959, and Complexes 31 and 32 were partially constructed on the same site in 1959 and 1960.[54] Existing facilities were reused, where possible. The majority of the following physical description is based upon a comparison of the *Basic Information Guides* from 1958, 1960, 1981, and 2000, as well as analysis of the 1957 *Master Plan*, Real Property Cards, and the As-Built Drawings completed by Steward and Skinner and Maurice H. Connell & Associates, Inc. and the United States Army Corps of Engineers in 1956 and 1957.[55]

Launch Complex 9/10 consisted of two Launch Pads (Facilities No.17700 – currently designated as a Missile Launch Test Facility, and No.17756 - currently designated as a Training Aid/ Museum Building) serviced by one Blockhouse (Facility No.17766 – currently designated as a Museum Building).[56] According to the 1958 *Basic Information Guide* and the As-Built Drawings, ancillary structures included a Pump House and Reservoir (now a Warehouse Support

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[53] Real Property Cards, Launch Pad 9 and Launch Pad 10, Cape Canaveral Air Force Station, 45th Space Wing Office of History, Patrick Air Force Base; "Eastern Test Range Launch Complexes, Cape Canaveral AFS," 45th Space Wing Office of History, Patrick Air Force Base, 16 April 1991; Mark Cleary, Eastern Range Launches, (45th Space Wing Office of History, Patrick AFB, 11 December 2002); Mark Cleary, "45th Space Wing: Its Heritage, History & Honors 1950-2001, Launch Facilities & Programs: Complexes 9/10" (45th Space Wing Office of History, Patrick AFB, 2001); Gibson, *The Navaho Missile Project*, 73.

[54] Information on Launch Complex 9/10 is also included in Susan I. Enscore, Julie L. Webster, Angela M. Fike,, and Martin J. Stupich, "Historic American Engineering Record: Level II Documentation of Launch Complex 31/32, Cape Canaveral Air Force Station, Florida." HAER FL-8-12, (Champaign, IL: ERDC-CERL), MP-08-02, 2008.

[55] United States Air Force, *Master Plan,* Cape Canaveral Missile Test Annex, 1957, Air Research and Development Command. Air Force Space and Missile Museum, Cape Canaveral Air Force Station; United States Air Force, "Real Property Accountable Record-Inventory Detail," Property Card 17780, Launch Complex 9/10 and 31 and 32 files, Space Gateway Support Company, GIS Real Property Office, John F. Kennedy Space Center; Real Property Cards, Launch Pad 9 and Launch Pad 10; Steward and Skinner and Maurice H. Connell & Associates, Inc., *Air Force Missile Test Center: Launching Facility – Navaho.* Site Plan and Drawings 201–23.768–67, 201–23.768–70, 201–23.768–71,768-96 (1956), Research Planning/Design Engineering Office, Kennedy Space Center; United States Army Corps of Engineers, *Air Force Missile Test Center: Wash Rack & Launching Facilities Navaho No. 2 Site Plan.* Drawing 201-24.426-1 (1957), Research Planning/Design Engineering Office, Kennedy Space Center; Pan American World Airways, Inc., *Basic Information Guide, 1958,* (Cape Canaveral Missile Test Annex, 1958), Research Planning/Design Engineering and Real Property Offices, Kennedy Space Center; Pan American World Airways, Inc., *Basic Information Guide, 1960*, (Cape Canaveral Missile Test Annex, 1960), Research Planning/Design Engineering and Real Property Offices, Kennedy Space Center; Pan American World Airways, Inc., *Basic Information Guide, 1981,* (Cape Canaveral Air Force Station, 1981), Research Planning/Design Engineering and Real Property Offices, Kennedy Space Center; Master Planning, *CCAFS Basic Information Guide: Facilities at CCAFS and KSC*.

[56] "Real Property List FY 2015," Real Property Office, Cape Canaveral Air Force Station, 2015.

Building, Facility No.17768), an Air Conditioning Building (now another Warehouse Support Building, Facility No.17706), Nitrogen Shed (Facility No.17767), two cable trenches between the Launch Pads and the Blockhouse, a Sentry Box, a Pre-launch Shelter, a Septic Tank (Facility No.17765 – replaced in 1978) to serve the Blockhouse, a Transformer Vault (part of the Blockhouse), Camera Pads for both Launch Pads, a Septic Tank to serve Launch Pad 9, and electrical, water, and fire suppression systems (Figure 8).[57] The complex was extensively altered in 1959 and 1960 with the construction of Launch Complex 31/32 on parts of the same site (Figure 9). As a result, several of the original facilities were demolished, while others were reused for other purposes. At present, the Blockhouse and Transformer Vault (Facility No. 17766), one associated cable trench, and surface remnants of its Septic Tank (Facility 17765), Pump House and Reservoir (Facility No. 17768), Air Conditioning Building (Facility No.17706), Launch Pad 10 (reused as Launch Pad 31A; Facility No.17700), Launch Pad 9 (Facility No.17756), and the 1970 Maintenance Shop (Facility No. 17790) remain in place in an altered and deteriorated condition.[58] All remaining facilities are vacant. The Nitrogen Shed (Facility No.17767), the Pre-Launch Shelter, the Blockhouse Septic Tank (Facility No. 17765), the cable trench from the Blockhouse to Launch Pad 10, the Sentry Box, and the Septic Tank for Launch Pad 9 are no longer extant.

Launch Pad 9 (Facility No.17756), Launch Pad 10 (Facility No.17700), and Septic Tanks

Although Launch Pads 9 and 10 were designed to launch the Navaho and utilized the same Blockhouse, the two Pads featured different launching methods. Constructed between 1953 and 1955, Launch Pad 9, located approximately 450' southwest of the Blockhouse, consisted of an oval-shaped, reinforced concrete Pad with a 115'-0" radius (Figure 10). Centered on the Pad, a two-story, reinforced concrete Pedestal measuring 66'-8" x 30'-0" with a fold-away erector gantry was used to launch the missile. The gantry, known as the Taj Mahal by the engineers, would raise the missile to the Pedestal’s top deck in preparation for a launch and provided access to the missile when in place. The Pedestal featured a full-scale static firing, water-cooled flame deflector and four special purpose equipment rooms incorporating 2,800 square feet of space. The special purpose equipment rooms housed launcher support equipment including a water spray system that cooled the exhaust plume during engine ignition. Cable trenches between the

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[57]Pan American World Airways, Inc., *Basic Information Guide,* 1958; United States Air Force, Property Card 17780, Launch Complex 9/10 files; Steward and Skinner and Maurice H. Connell & Associates, Inc., *Air Force Missile Test Center: Launching Facility – Navaho.* Site Plan and Drawings 201–23.768–67, 201–23.768–70, 201–23.768–71, 201-23.768-96; United States Army Corps of Engineers, Drawing 201-24.426-1.

[58] Master Planning, *CCAFS Basic Information Guide.*

Launch Pad, the Blockhouse, and the Air Conditioning Building protected the circuitry, potable water, fire, and high-pressure air lines from destruction during a launch and allowed workers in the Blockhouse to remotely control launch operations. The Septic Tank which served the facility was located west of the Launch Pad. The Pedestal underwent two months of significant repairs after a missile exploded on the Pad on April 25, 1957. This led to the redesign of some of the ground equipment and the missile.[59]

Located approximately 800' southeast of the Blockhouse, Launch Pad 10 was a hexagonally-shaped reinforced concrete pad measuring approximately 250' x 200' (Figure 11). The missile set on the portable Navaho launch stand was serviced by a movable service tower approximately 63' tall. Set on rails, the service tower could be moved from the center of the Pad to the northwest edge of the Launch Pad. Cable trenches between the Launch Pad, the Blockhouse, and the Nitrogen Shed protected the circuitry, potable water, fire, and high pressure air lines from destruction during a launch and allowed workers in the Blockhouse to remotely control launch operations. A concrete Restroom Building approximately 10' x 15' was located north of (behind) a concrete Blast Wall approximately 88' x 5'. The Septic Tank which served the facility was located northwest of the Launch Pad.[60] A drainage and trenching system provided for water and fuel runoff from the Launch Pads to a drain field. Camera stations were concrete pads adjacent to the Launch Pads which were wired for use by photographers.[61]

During the summer of 1958, Launch Pad 10 was reassigned to support the Jason research rocket which was launched from a mobile launcher set in the middle of the Pad. Late in 1958, the Pad was modified to launch the Alpha Draco. A concrete flame deflector was poured and tie-down points were installed at the west edge of the Pad (Figure 12). Following the three launches of the Alpha Draco, the entire complex was deactivated. Soon thereafter, Pad 10 was altered to serve as Launch Pad 31A, constructed to launch the Minuteman missile. Alterations included the demolition of the Blast Wall and Restroom Building, the excavation of an underground room, and the construction of a new service structure.[62] Initially, the four special purpose equipment

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[59] Steward and Skinner and Maurice H. Connell & Associates, Inc., Drawing 201-23.768-67; United States Army Corps of Engineers, Drawing 201-24.426-1; United States Air Force, Property Card 17780, Launch Complex 9/10 files; Property Card, Launch Pad 9 and Launch Pad 10; Gibson, *The Navaho Missile Project*, 69-70.

[60] United States Air Force, Property Card 17780, Launch Complex 9/10 files; United States Army Corps of Engineers, Drawing 201-24.426-1; Property Card, Launch Pad 9 and Launch Pad 10.

[61] United States Air Force, Property Cards 17780 and 17700, Launch Complex 9/10 files; United States Army Corps of Engineers, Drawing 201-24.426-1; Steward and Skinner and Maurice H. Connell & Associates, Inc., Drawing 201-23.768-67.

[62] United States Air Force, Property Cards 17780 and 17700, Launch Complex 9/10 files; Al Hartmann, Volunteer, Air Force Space and Missile Museum, interview by author and e-mail, 30 April and 16 June 2003, CCAFS, notes from interview,

rooms in the Pedestal at Launch Pad 9 were enclosed with concrete block to serve as storage space. The structure was later abandoned in place in May 1971.[63]

Blockhouse (Facility No.17766), Transformer Vault, and Septic Tank (Facility No.17765)

The reinforced concrete Blockhouse (Facility No.17766) held the instrumentation, control consoles, and communications for the complex (Figure 13). Incorporating 1,854 square feet of space including the Transformer Vault, the one-story Blockhouse was partially set in the ground on a 6" concrete slab foundation on sand fill lined with a waterproof membrane. The reinforced concrete building had a flat roof over the southwestern end, and a concrete barrel roof over the majority of the building. Operating as the launch control center, the northeast entrance to the Blockhouse led to a Shop & Lab flanked by a Utility Room and a Toilet Room. The Shop & Lab led to the Operations Room with the control consoles utilized by personnel to remotely control a launch (Figure 13). Armored glass vision ports with glass mirrors reflected a view of the Launch Pads. Circuitry in cable trenches extended from the Launch Pads and entered the Blockhouse through a Pit in the northwest corner of the room. The Pit connected to a cable trench around the perimeter of the Observation Room. All rooms retained their exposed concrete walls. The Toilet Room had the exposed concrete slab floor and ceiling, while the other rooms featured suspended acoustical tile ceilings and asphalt tile floors. An additional entrance to the Observation Room on the northwest wall was accessed through a poured concrete two-walled entry shelter.[64]

Originally, the southwest wall of the Blockhouse facing Launch Pad 9 was constructed of concrete with vision ports set behind an additional concrete retaining wall reinforced with mounded earth separated by a waterproof membrane. Mirrors, located in the space between the Blockhouse and the retaining wall, and tempered glass windows forming the upper portion of the retaining wall, provided a view of Launch Pad 9. The tempered glass windows could be covered by metal rolling doors during a launch (Figure 13). One observation window on the southeast wall provided a view of Launch Pad 10. During the third launch on April 25, 1957, the Navaho exploded on the Pedestal at Launch Pad 9. The Blockhouse underwent significant alterations while repairs were made to the Pedestal from April through mid-June. Both the southwest and

Archaeological Consultants, Inc., Sarasota; Joel W. Powell, "Uncovering Old Pad 10: The Search for the Draco Launch Site at Cape Canaveral," 257.

[63] United States Air Force, Property Card 17780, Launch Complex 9/10 files; United States Air Force, Voucher No. 72-1114; Master Planning, *CCAFS Basic Information Guide*.

[64] Steward and Skinner and Maurice H. Connell & Associates, Inc., Drawing 201-23.768-70, 201-23.768-71, 201-23.768-96; United States Air Force, Property Card 17780, Launch Complex 9/10 files.

southeast walls were reinforced to further protect the Blockhouse. The retaining wall with tempered glass windows and metal rolling doors was replaced by a retaining wall that extended to the roofline of the Blockhouse and around the southeast wall. Additional mounded earth was added to further insulate the wall; it was covered with shotcrete to further protect and hold the earth in place. Additional vision ports were installed on the southeast wall, and additional mirrors were added above the wall on the southeast and southwest for a view of the launches.[65]

Extensions off of the northeast wall included housing for an air conditioning compressor and a breezeway connecting to the Transformer Vault. An open breezeway with a concrete floor covered by a built-up roof connected the Blockhouse to the Transformer Vault. The reinforced concrete Transformer Vault had a concrete slab floor and a built-up roof. The entrance was on the southeast wall, while window openings covered by metal louvers extended along the northeast wall. Electrical power was distributed throughout the complex by approximately 800' of Electrical Distribution Lines.[66] A Septic Tank served the Blockhouse, but the tank was replaced in 1978 and removed by 2008 (Facility No.17765).[67]

Following the Navaho, Jason, and Alpha Draco programs, the Blockhouse was altered in 1962 to serve as the Administration and Engineering Office Building. The mechanical equipment and control consoles were removed and the interior of the Blockhouse was renovated. Carpet was installed over the original asphalt tile floor and walls were constructed to divide the Operations Room into four separate rooms. The breezeway between the Blockhouse and the Transformer Vault was enclosed with concrete-block for a restroom facility. In 1978, the building was converted to the 2nd Combat Communications Group Instructor’s Quarters. In 2001, the name reverted to the Navaho Blockhouse according to the Real Property records.[68] The facility housed offices until at least 2007; by 2014 it was categorized as a Museum Building.[69]

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[65] Steward and Skinner and Maurice H. Connell & Associates, Inc., Drawing 201-23.768-70, 201-23.768-71, 201-23.768-96; United States Air Force, Property Cards 17780 and 17766, Launch Complex 9/10 files; Gibson, *The Navaho Missile Project*, 69-70; United States Air Force, *Master Plan,* Photograph of Blockhouse: Building Number 5-1318.

[66] Steward and Skinner and Maurice H. Connell & Associates, Inc., Drawing 201-23.768-70, 201-23.768-71, 201-23.768-96; United States Air Force, Property Cards 17780 and 17766, Launch Complex 9/10 files.

[67] Master Planning, *CCAFS Basic Information Guide*; United States Air Force, Property Card 17780, Launch Complex 9/10 files.

[68] United States Air Force, Property Cards 17780 and 17766, Launch Complex 9/10 files; United States Air Force, Voucher No. 63-1261 and 78-1113; Pan American World Airways, Inc., *Basic Information Guide*, 1960; Hartmann, 2003; Master Planning, *CCAFS Basic Information Guide*.

[69] Thomas Penders, “Historical Structure Form 8BR2185, Florida Master Site File.” (Cape Canaveral, FL: 45th Space Wing), 2007; “Real Property List FY 2015,” Real Property Office, Cape Canaveral Air Force Station, 2015.

Pump House and Reservoir/Museum Rocket Restoration Facility (Facility No.17768)

The Pump House and Reservoir (Facility No.17768) is now a Warehouse Supply and Equipment facility, was located approximately 80' northeast of the Blockhouse and Transformer Vault (Figure 14). Containing 3,548 square feet of space, the Pump House occupied the northwestern half of the building, while the Reservoir occupied the southeastern half of the building. Set on a concrete slab foundation, the southeastern half of the building was constructed of reinforced concrete, while the northwestern half was supported by columns of reinforced concrete separated by vented openings. Paired metal doors with fixed six-lights windows were located on the northwestern wall (now replaced with solid metal doors). A shallow gable roof covered the building with a small gabled skylight centrally located in the southeastern part of the building. A water tank was southwest of the building, and a small storage building was to the south. After the deactivation of Launch Complex 9/10, the building was converted to a Support Shop and vents located on the northwestern wall of the building were enclosed with concrete block and three-and four-light awning windows. From 1978 until 2000, the building served as a training facility for the 2nd Combat Communications Group. In 2000, it was reassigned as a Museum Rocket Restoration Facility.[70] It was reassigned as a storage facility in either 2009 or 2010.

Nitrogen Shed/Museum Rocket Restoration Facility (Facility No.17767)

The Nitrogen Shed (Facility No.17767), now a Museum Rocket Restoration Facility, was located approximately 18' northwest of the Transformer Vault. The building first appears on the 1957 Site Plan for the construction of Launch Pad 10. The 676 square feet building held batteries of Nitrogen bottles utilized to purge high pressure gas lines. The reinforced concrete building was set on a concrete slab foundation and had a metal gable roof covered with corrugated metal. Following the deactivation of Launch Complex 9/10 in 1959, the Nitrogen Shed was converted to a Pad Service Building. At this time, an open porch was enclosed and the roof was elevated. The new areas were enclosed with concrete block and one-light awning windows. A one-story shed was added on the southwest wall. In 1978, the building was converted to a Latrine.[71] The building was extensively damaged by a hurricane in 2004, and was demolished in 2006.

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[70] United States Air Force, Property Cards 17780 and 17768, Launch Complex 9/10 files; United States Air Force, Voucher No. 62-1395 and 78-1113; United States Army Corps of Engineers, Drawing 201-24.426-1; Steward and Skinner and Maurice H. Connell & Associates, Inc., Drawing 201-23.768-67.

[71] United States Air Force, Property Cards 17780 and 17767, Launch Complex 9/10 files; United States Air Force, Voucher No. 78-1113; United States Army Corps of Engineers, Drawing 201-24.426-1; Steward and Skinner and Maurice H. Connell & Associates, Inc., Drawing 201-23.768-67; Master Planning, *CCAFS Basic Information Guide*.

Air Conditioning Building/ Storage Building (Facility No.17706)

A small concrete block Air Conditioning Building (Facility No.17706), now a Storage Building, was located immediately southeast of Launch Pad 9 (Figure 15). It was included in the 1957 *Master Plan* and was evident in the site plan included in the 1958 *Basic Information Guide*. By 1960, it was identified in the *Basic Information Guide* as the Air Conditioning Building and appears to have held a compressor utilized to cool the rooms in the Pedestal at Launch Pad 9. Incorporating 225 square feet of space, the concrete block building featured a concrete slab foundation and a flat roof. Following the deactivation of Launch Pad 9 in 1959, the Air Conditioning Building was converted to serve as a Locker and Tool Building. Now vacant, it is listed as a Storage Building.[72]

Pre-launch Shelter

Typical of temporary shelter structures utilized at Air Force bases during the post-World War II era, the Pre-launch Shelter at Launch Complex 9 was a temporary metal shelter on wheels covered by a canvas awning (Figure 16). The wheels moved the shelter along a pair of rails running southeast from the Pedestal for a distance of approximately 245'.[73] Although not identified on either the 1958 or 1960 *Basic Information Guide,* the Pre-launch Shelter was identified in the 1957 *Master Plan* as the canopy for Pad 9. As a mobile facility, historic photographs show this structure southeast of the Launch Pad near the southern entrance to the complex (Figure 17). It provided shelter from the weather for the missile and crews and appears to have been removed from its location adjacent to Launch Pad 9 following the deactivation of the complex.[74]

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[72] United States Air Force, Property Cards 17780 and 17706, Launch Complex 9/10 files; Pan American World Airways, Inc., *Basic Information Guide, 1958;* Pan American World Airways, Inc., *Basic Information Guide, 1960;* Master Planning, *CCAFS Basic Information Guide;* United States Air Force, *Master Plan,* Photograph Air Conditioning Building: Building Number 5-1317.

[73] Penders, "Historical Structure Form 8BR2185."

[74] Pan American World Airways, Inc., *Basic Information Guide*, 1958; Pan American World Airways, Inc., *Basic Information Guide*, 1960; August 1956 Aerial Photograph of Launch Complex 9 -10, University of Central Florida, Florida Space Coast History Project, scanned copy provided courtesy of Al Hartmann; Cleary, "Launch Facilities & Programs: Complexes 9/10"; Gibson, *The Navaho Missile Project*, 60; United States Air Force, *Master Plan,* Photograph Canopy for Pad 9: Building Number 5-1318A.

Sentry Box

A Sentry Box was located at the southern edge of the complex, along the entrance from Lighthouse Road. Included in the plans for the construction of Launch Pad 10, it appears to have been removed around 1960 during the construction of Complex 31 and 32.[75]

Maintenance Shop

A semipermanent metal building (Facility No. 17790) was erected in 1970 at a cost of $6,051, to serve as a Maintenance Shop during the last months of the Minuteman program at Launch Complex 31/32.[76] The building is located directly adjacent to Launch Pad 9, along its southeastern edge.[77] The 50' x 40' building has a concrete foundation, a concrete floor, and metal walls and front-gabled roof. There are three vent stacks along the roof ridge. The southeast facade contains an opening that parts at the center and slides horizontally, like a hangar door. The northwest facade has two smaller cargo doors. By 1976, the building was being categorized as a Storage Building and used for storing RCA Timing Trailers, part of the communication system at Cape Canaveral.[78] By 1985, the building was used as a generic storage facility and categorized as Warehouse Supply and Equipment Base.[79] This categorization was supplemented with "Museum Rocket Restoration Facility" from 2003, but after 2010, the additional designation had been removed.[80] Facility No. 17790 currently remains categorized as a Warehouse Supply and Equipment facility, but it was abandoned in May 2013.[81]

Conversion and Deactivation

Following the conclusion of the Navaho and Jason programs in 1958, Launch Pad 10 was reassigned to launch the Alpha Draco. A concrete flame deflector was poured and tie-down points were installed at the west edge of the Pad in order to launch the missile. After the final

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[75] United States Army Corps of Engineers, Drawing 201-24.426-1.

[76] Real Property Card, "Facility 17790," Real Property Office, Cape Canaveral Air Force Station.

[77] The building's location on the Launch Complex 9/10 site warrants its inclusion in this documentation, although it was not historically associated with activities at Launch Complex 9/10.

[78] Pan American World Airways, Inc., *Basic Information Guide*, 1977.

[79] Pan American World Services, Inc., *Basic Information Guide*, 1985.

[80] *Cape Canaveral Spaceport Facilities: CCAFS/KSC Basic Information Guide*, (Cape Canaveral, FL: Kennedy Space Center), 2003; Real Property List FY 2014," Real Property Office, Cape Canaveral Air Force Station, 2014.

[81] "Real Property List FY 2015," Real Property Office, Cape Canaveral Air Force Station, 2015.

Alpha Draco launch in April 1959, the Air Force deactivated Launch Complex 9/10. However, many of the facilities were reused as part of Launch Complex 31/32 when it was constructed on the same site. Initiated in July 1959, the new Minuteman missile complex was essentially built on top of the old complex, reusing some of the structures, while demolishing others. Launch Complex 31/32 consisted of two flat concrete pads, Pads 31A and 32A, and two underground silo launch sites, Pads 31B and 32B, serviced by two new Blockhouses. Launch Pad 31A was the former Launch Pad 10. Alterations included the demolition of the Blast Wall, Restroom Building, and cable trench; the excavation of an underground room; and the construction of a new service structure.[82] The Pedestal at Launch Pad 9 was converted to a storage building necessitating the enclosure of the four special purpose equipment rooms in the structure in 1959. The Pedestal was later abandoned in place in May 1971, and all of the machinery, hardware, and interior finishes had been removed by that point.[83] In 2004, a plan to reuse parts of Complex 31/32 for Force Protection Training resulted in Launch Pad 9 being designated a "Force Protection Training Area" by 2007, and today the facility is classified as a Training Aid/Museum Building.[84]

With the construction of Launch Complex 31/32, the Sentry Box and Pre-launch Shelter were apparently removed. The Air Conditioning Building was converted to serve as a Locker and Tool Building. The Blockhouse was converted to the Administration and Engineering Office Building resulting in the removal of the mechanical equipment and control consoles. The interior of the Blockhouse was also renovated, and the open breezeway was enclosed to form a restroom facility. At the same time, the Pump House and Reservoir was converted to a Support Shop resulting in the removal of vents and enclosure of the northwestern half of the building with concrete block infill and awning windows. Additionally, the Nitrogen Shed was enlarged and renamed the Pad Service Building. In 1978, the Pump House and Reservoir was transferred to serve as a training facility for the 2nd Combat Communications Group, while the Blockhouse was converted to house the 2nd Combat Communications Group Instructor's Quarters. The Nitrogen Shed was altered to serve as a Latrine. In 2000, both the Pump House and Reservoir and the Nitrogen Shed were reassigned as Museum Rocket Restoration Facilities. At the same time, the

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82 United States Air Force, Property Cards 17780 and 17700, Launch Complex 9/10 files; Hartmann, 2003; Powell, 257.

83 United States Air Force, Property Card 17780, Launch Complex 9/10 files; United States Air Force, Voucher No. 72-1114; Master Planning, *CCAFS Basic Information Guide*.

84 "Real Property List FY 2015," Real Property Office, Cape Canaveral Air Force Station, 2015.

Blockhouse reverted to the designation as Navaho Blockhouse. The Air Conditioning Building is now a Storage Building.[85] The Nitrogen Shed was demolished in 2006.

Many of the facilities associated with Launch Complex 9/10 remain in place. The concrete shell of the Pedestal at Launch Pad 9 remains vacant and abandoned in place. The Air Conditioning Building remains in an altered and deteriorated condition, while the Blockhouse and Pump House and Reservoir are in fair condition. Many of the original fixtures and finishes in the Blockhouse are intact.

For additional information and current condition photographs for the former Launch Pad 10, see HAER No. FL-8-12, Level II Documentation of Launch Complex 31/32 (2008).

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[85] United States Air Force, Property Cards 17706, 17780, 17766, 17767, and 17768, Launch Complex 9/10 files; United States Air Force, Voucher No. 62-1395, 63-1261, and 78-1113; United States Army Corps of Engineers, Drawing 201-24.426-1; Steward and Skinner and Maurice H. Connell & Associates, Inc., Drawing 201-23.768-67; Pan American World Airways, Inc., *Basic Information Guide*, 1960; Hartmann, 2003; Master Planning, *CCAFS Basic Information Guide*.

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Photographs. Air Force Space and Missile Museum, Cape Canaveral Air Force Station. Scanned copy provided courtesy of Al Hartmann.

Photographs. 45th Space Wing History Office, Patrick Air Force Base. Scanned copy provided courtesy of Al Hartmann.

Photographs. University of Central Florida, Florida Space Coast History Project. Scanned copy provided courtesy of Al Hartmann.

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HISTORIC DRAWINGS

As of 2016, the technical drawings used for research in this study have not been cleared for release to the public domain. It is, therefore, not possible to reproduce in this document the drawings used to gather information about the design, construction, and use of facilities at Launch Complex 9/10, CCAFS.

APPENDIX: FIGURES FROM DATA PAGES

Figure 1. Location of Launch Complex 9/10, CCAFS. Air Force Space and Missile Museum.

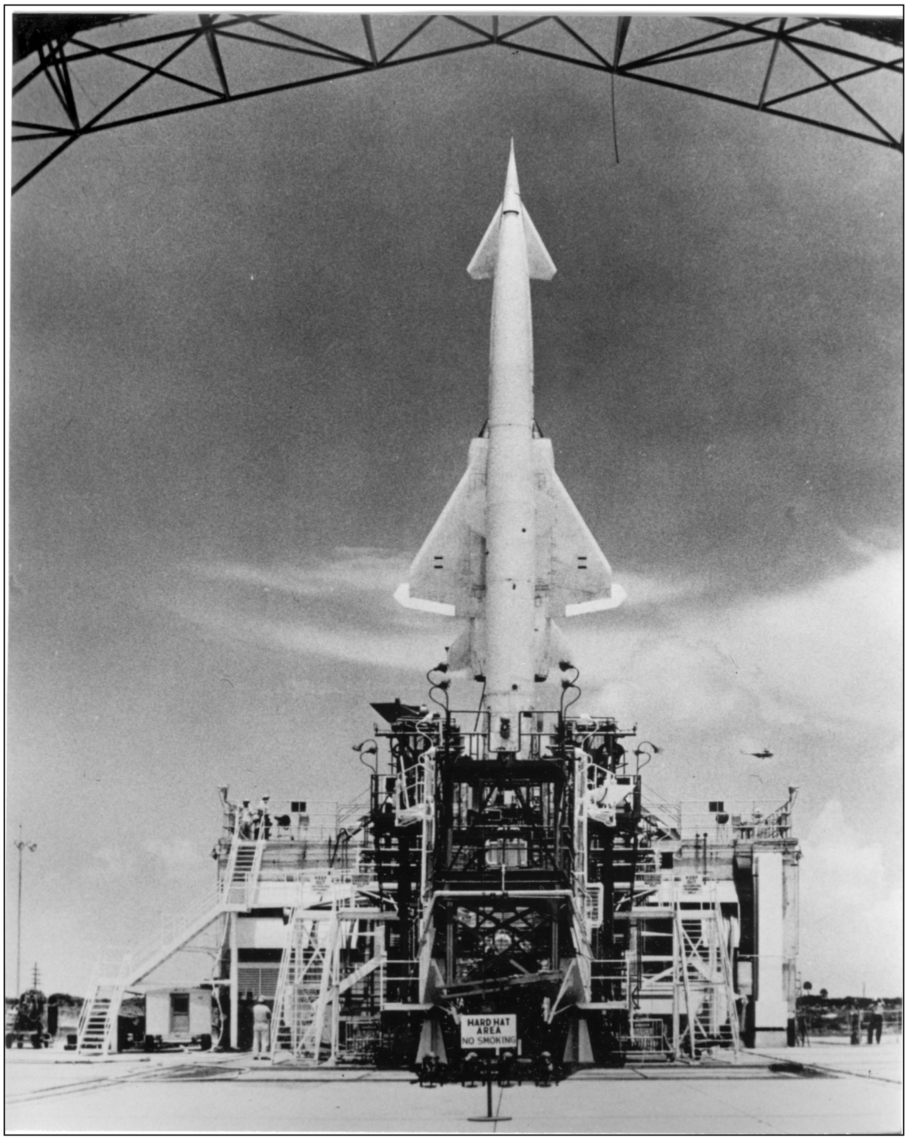

Figure 2. Navaho on Pedestal at Launch Pad 9. 1957. Photograph 12navvpz, located at 45th Space Wing History Office, Patrick Air Force Base.

Figure 3. Navaho missile lowered onto Mobile Launcher at Pad 10, date unknown. Photograph 57-PL-23809, RCA, located at 45th Space Wing History Office, Patrick Air Force Base.

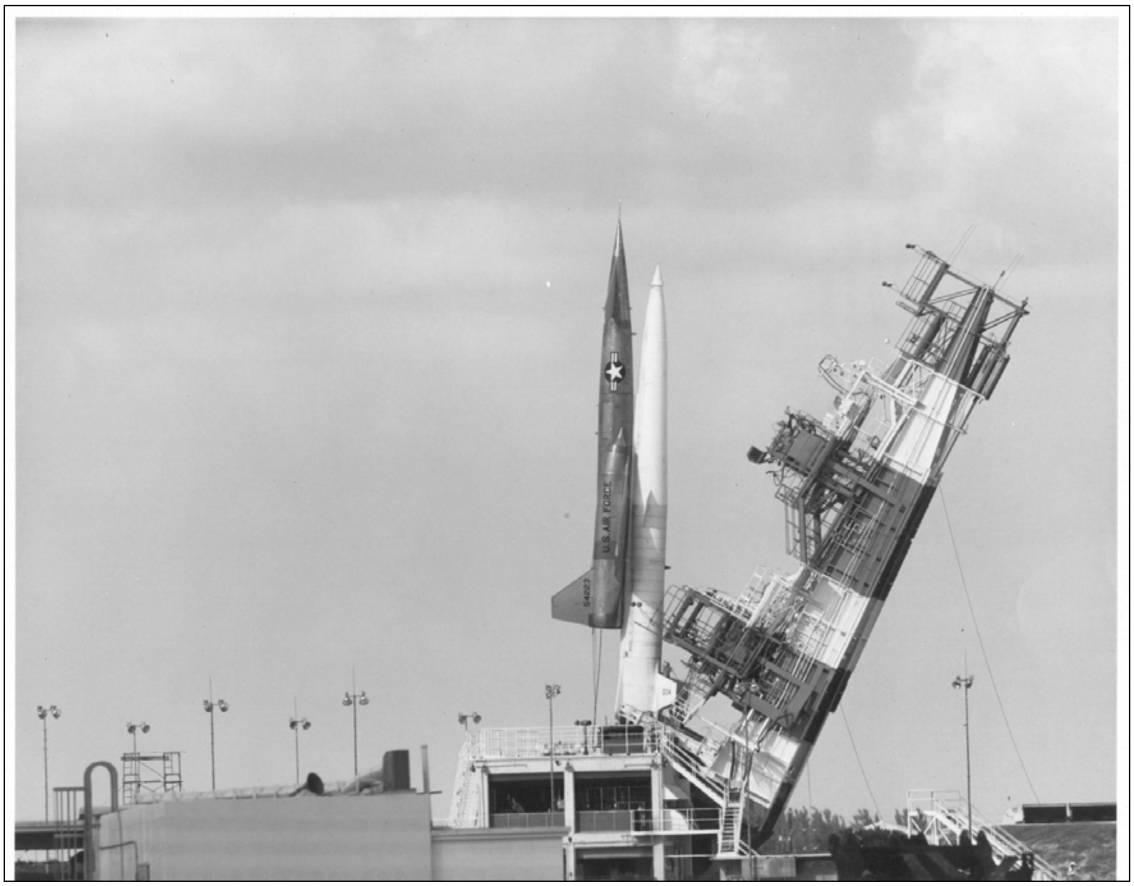

Figure 4. Preparation for Project RISE launch at Launch Pad 9, 1958. Photograph 58-PL-58-45820, RCA, located at 45th Space Wing History Office, Patrick Air Force Base.

Figure 5. Jason Research Rocket at Launch Pad 10, 1958. Photograph Jason-001-ah, located at University of Central Florida, Florida Space Coast History Project.

Figure 6. Launch preparations for Alpha Draco at Launch Pad 10, 1959. Photograph 59-11891, Bionetics Corporation, located at U.S. Air Force Space and Missile Museum, Cape Canaveral Air Force Station.

Figure 7. Final Alpha Draco launch from Pad 10, April 1959. Photograph PL-59-15398, RCA, located at U.S. Air Force Space and Missile Museum, Cape Canaveral Air Force Station.

Figure 8. Aerial of Launch Complex 9/10, August 1956. Launch Pad 9 at top of photo, Blockhouse and Service area at center right, and Launch Pad 10 in lower half. Photograph located at University of Central Florida, Florida Space Coast History Project.

Figure 9. View of the site showing Launch Complex 31/32 and Launch Complex 9/10, September 13, 1979. The Pedestal is on the far right, with Launch Pad 31A (previously Launch Pad 10) upper right quadrant. The Launch Complex 9/10 Blockhouse is in the center of the image, with the Pump House and Reservoir across the road to the left. Photograph located at U.S. Air Force Missile and Space Museum, Cape Canaveral Air Force Station.

Figure 10. Navaho on erector gantry at Launch Pad 9, date unknown. Photograph located at University of Central Florida, Florida Space Coast History Project.

Figure 11. Overall view of Pad 10, date unknown. From left to right: Navaho Service Tower, Blast Wall, and Restroom Building, Mobile Launcher, and Test Navaho. Photograph 16989, RCA, U.S. Air Force. Photograph located at 45th Space Wing History Office, Patrick Air Force Base.

Figure 12. Alpha Draco at Launch Pad 10. Note the Flame Deflector and tie-down points. 1959. Photograph located at Air Force Space and Missile Museum, Cape Canaveral Air Force Station.

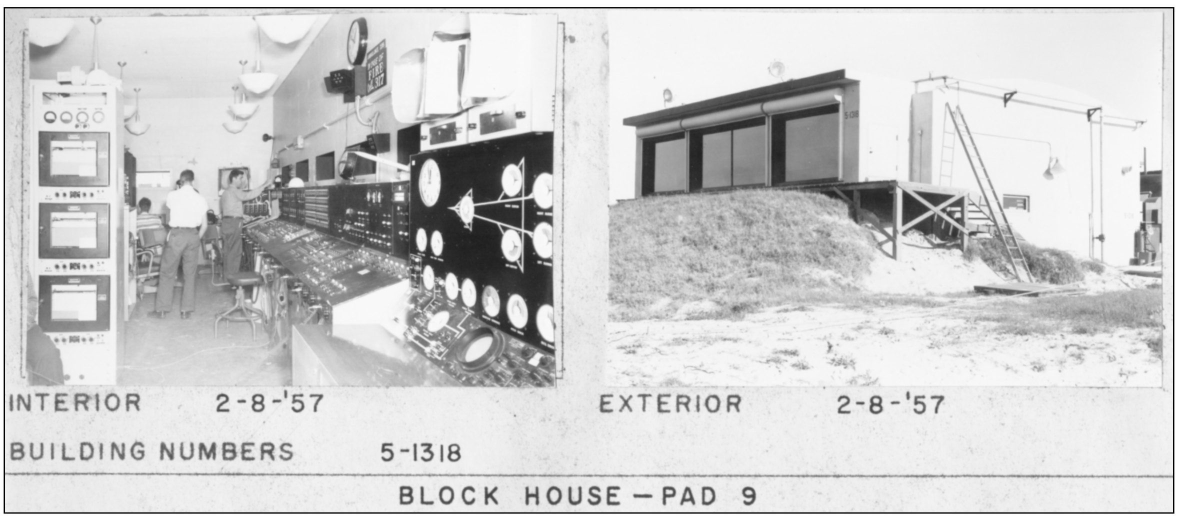

Figure 13. Blockhouse, 1957. United States Air Force, *Master Plan*, Cape Canaveral Missile Test Annex, 1957, Air Research and Development Command. Photograph located at Air Force Space and Missile Museum, Cape Canaveral Air Force Station.

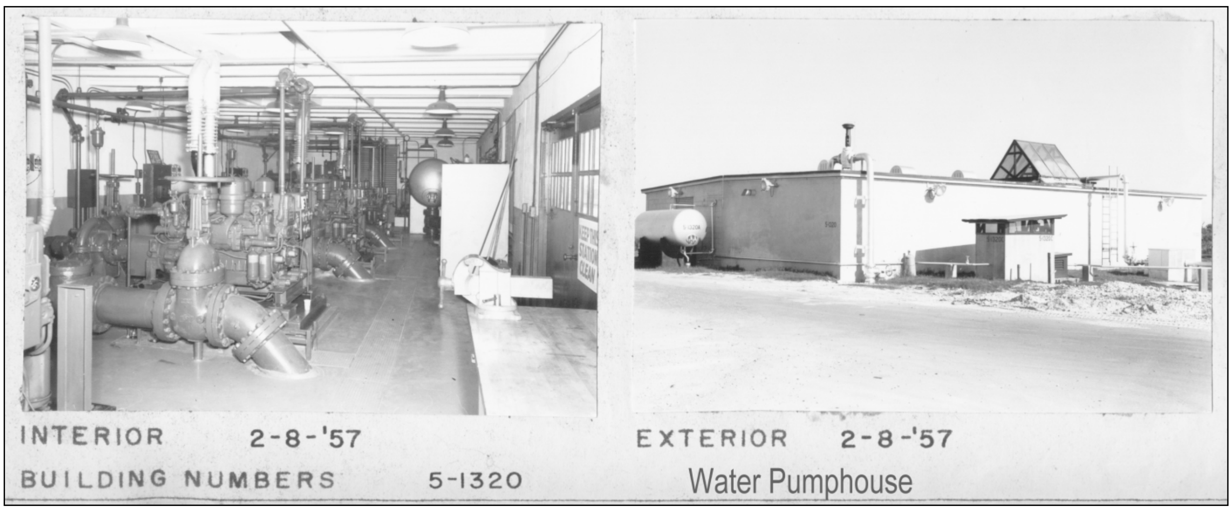

Figure 14. Pump House and Reservoir, 1957. United States Air Force, *Master Plan*, Cape Canaveral Missile Test Annex, 1957, Air Research and Development Command. Photograph located at Air Force Space and Missile Museum, Cape Canaveral Air Force Station.

Figure 15. Air Conditioning Building, 1957. United States Air Force, *Master Plan*, Cape Canaveral Missile Test Annex, 1957, Air Research and Development Command. Photograph located at Air Force Space and Missile Museum, Cape Canaveral Air Force Station.

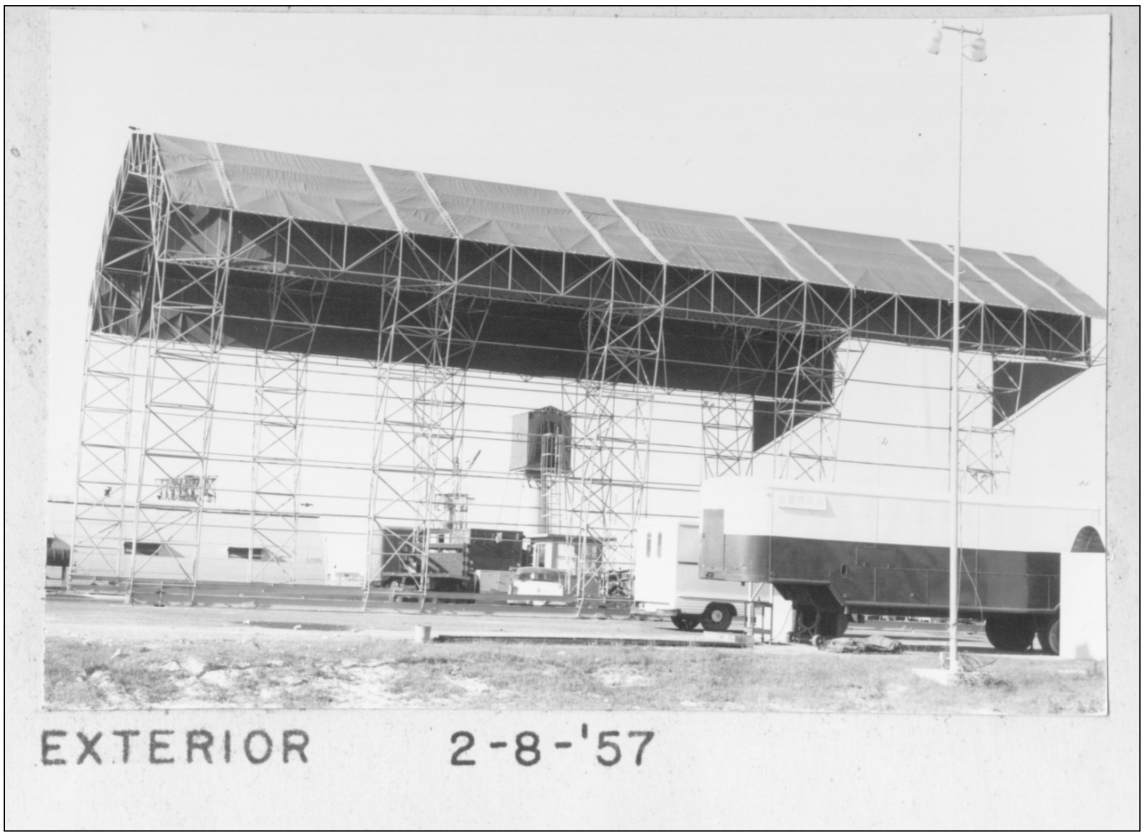

Figure 16. Pre-Launch Shelter, 1957. United States Air Force, *Master Plan*, Cape Canaveral Missile Test Annex, 1957, Air Research and Development Command. Photograph located at Air Force Space and Missile Museum, Cape Canaveral Air Force Station.

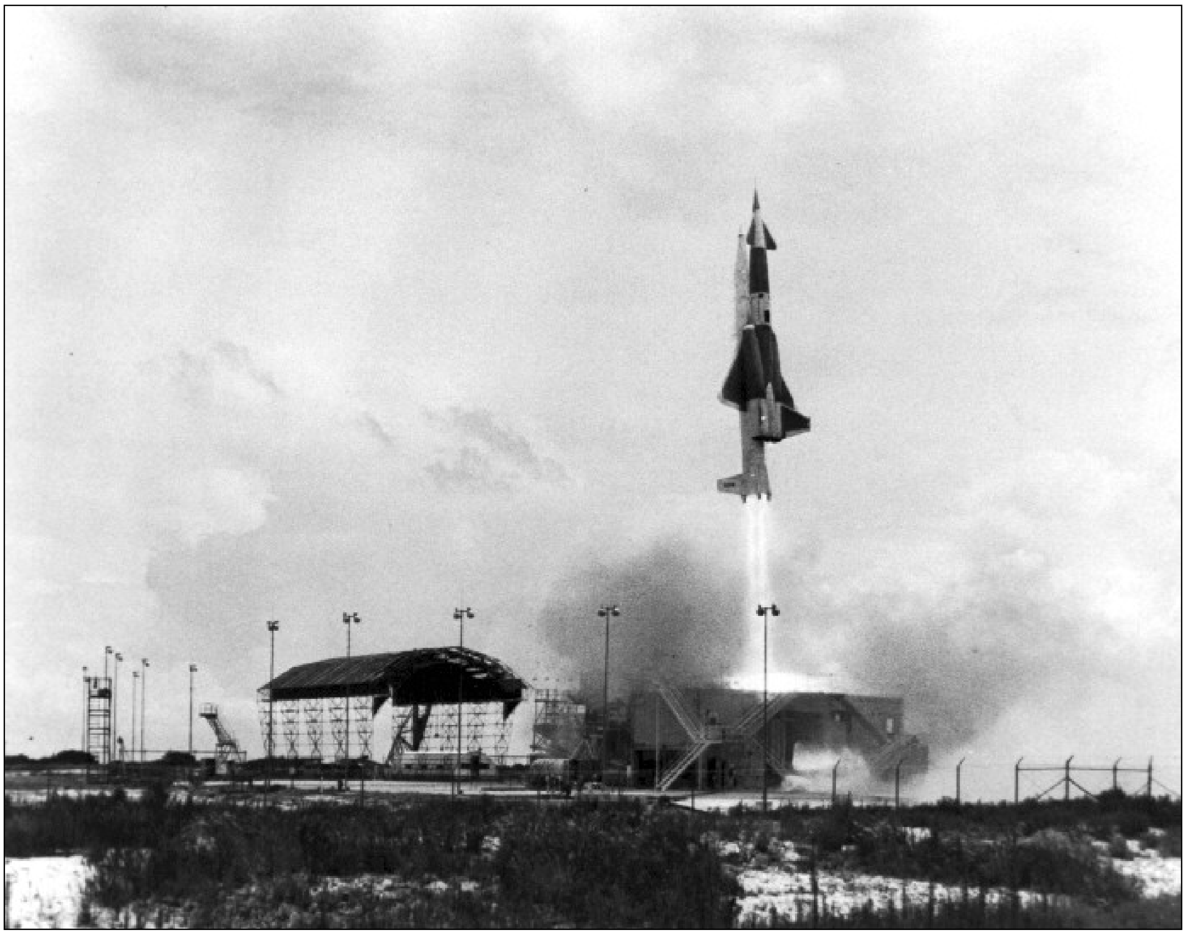

Figure 17. Navaho launch from Pedestal at Launch Pad 9, June 26, 1957. Note location of Pre-Launch shelter to left of Launch Pedestal. Photograph 12navlaz, U.S. Air Force. Located at 45th Space Wing History Office, Patrick Air Force Base.

CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 9/10 HAER No. FL-8-10

North side of Lighthouse Road, 0.9 miles north of Pier Road intersection
Cape Canaveral
Brevard County
Florida

PHOTOGRAPHS

HISTORIC AMERICAN ENGINEERING RECORD
Southeast Regional Office
National Park Service
U. S. Department of the Interior
100 Alabama Street, S.W.
Atlanta, GA 30303

HISTORIC AMERICAN ENGINEERING RECORD

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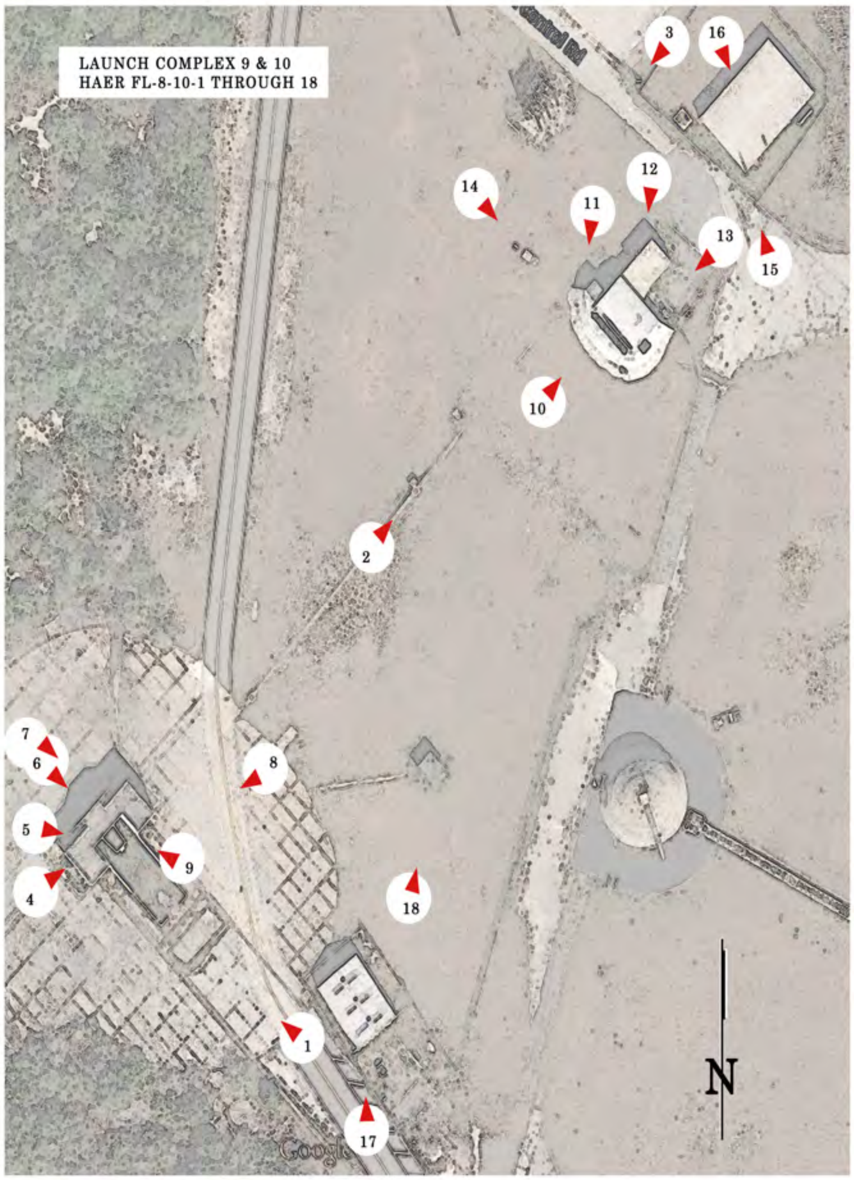
CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 9/10 — HAER No. FL-8-10

North side of Lighthouse Road, 0.9 miles north of Pier Road intersection
Cape Canaveral
Brevard County
Florida

INDEX TO BLACK AND WHITE PHOTOGRAPHS

Photographer: Martin Stupich, 2014
See photo key on page 2 of Index to Photographs

FL-8-10-1	LAUNCH PAD 9 (17756) SOUTHEAST FACADE FROM SITE OF PRE-LAUNCH SHELTER BUILDING (REMOVED CA. 1960); VIEW TO NORTHWEST (on photo key as #1)
FL-8-10-2	CONCRETE CABLE TRENCH BETWEEN LAUNCH PAD AND BLOCKHOUSE, NOTE MANHOLE ACCESS COVERS; VIEW TO NORTHEAST (on photo key as #2)
FL-8-10-3	FREE-STANDING THEODOLITE OR OTHER TRACKING EQUIPMENT MOUNT, WEST OF 17766; VIEW TO SOUTHWEST (on photo key as #3)



Photograph Key for Entire Complex.

HISTORIC AMERICAN ENGINEERING RECORD
CAPE CANAVERAL AIR FORCE STATION
LAUNCH COMPLEX 9 AND 10
SEE INDEX TO PHOTOGRAPHS FOR CAPTION
HAER No. FL-8-10-1

HISTORIC AMERICAN ENGINEERING RECORD
CAPE CANAVERAL AIR FORCE STATION
LAUNCH COMPLEX 9 AND 10
SEE INDEX TO PHOTOGRAPHS FOR CAPTION
HAER No. FL-8-10-2

HISTORIC AMERICAN ENGINEERING RECORD
CAPE CANAVERAL AIR FORCE STATION
LAUNCH COMPLEX 9 AND 10
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HAER No. FL-8-10-3

HISTORIC AMERICAN ENGINEERING RECORD

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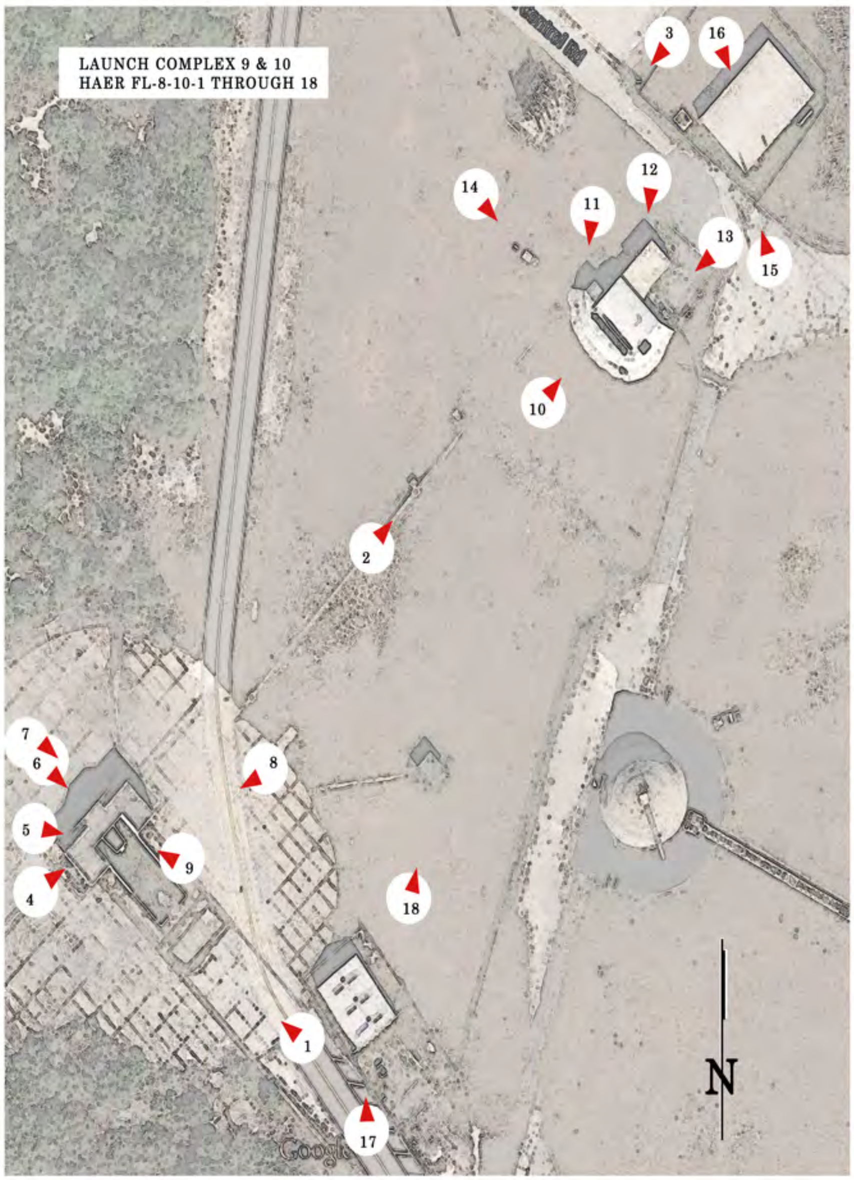
CAPE CANAVERAL AIR FORCE STATION, HAER No. FL-8-10-A
LAUNCH COMPLEX 9/10, FACILITY No. 17756
(LAUNCH COMPLEX 9/10, LAUNCH PAD 9)
North side of Lighthouse Road, 0.9 miles north of Pier Road intersection
Cape Canaveral
Brevard County
Florida

INDEX TO BLACK AND WHITE PHOTOGRAPHS

Photographer: Martin Stupich, 2014
See photo key on page 2 of Index to Photographs

FL-8-10-A-1	LAUNCH PAD 9 (No. 17756) SOUTHWEST FACADE OBLIQUE VIEW, WITH BEEHIVE BLOCKHOUSES 31/32 LEFT AND RIGHT; VIEW TO NORTHEAST (on photo key as #4)
FL-8-10-A-2	LAUNCH PAD 9 (No. 17756) NORTHWEST AND SOUTHWEST FACADES; VIEW TO NORTH (on photo key as #5)
FL-8-10-A-3	LAUNCH PAD 9 (No. 17756) NORTHWEST FACADE; VIEW TO SOUTHEAST (on photo key as #6)
FL-8-10-A-4	LAUNCH PAD 9 (No. 17756) NORTHWEST FACADE DETAIL, CENTRAL BLAST DEFLECTOR; VIEW TO SOUTHEAST (on photo key as #7)
FL-8-10-A-5	LAUNCH PAD 9 (No. 17756) OBLIQUE SOUTHEAST AND NORTHEAST FACADES; VIEW TO WEST (on photo key as #8)
FL-8-10-A-6	LAUNCH PAD 9 (No. 17756) DETAIL BLAST DEFLECTOR, SOUTHEAST FACADE; VIEW TO WEST (on photo key as #9)



Photograph Key for Entire Complex

HISTORIC AMERICAN ENGINEERING RECORD
CAPE CANAVERAL AIR FORCE STATION
LAUNCH COMPLEX 9 AND 10
SEE INDEX TO PHOTOGRAPHS FOR CAPTION
HAER No. FL-8-10-A-1

HISTORIC AMERICAN ENGINEERING RECORD
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HISTORIC AMERICAN ENGINEERING RECORD
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LAUNCH COMPLEX 9 AND 10
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HAER No. FL-8-10-A-4

HISTORIC AMERICAN ENGINEERING RECORD
CAPE CANAVERAL AIR FORCE STATION
LAUNCH COMPLEX 9 AND 10
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HAER No. FL-8-10-A-5

HISTORIC AMERICAN ENGINEERING RECORD
CAPE CANAVERAL AIR FORCE STATION
LAUNCH COMPLEX 9 AND 10
SEE INDEX TO PHOTOGRAPHS FOR CAPTION
HAER No. FL-8-10-A-6

HISTORIC AMERICAN ENGINEERING RECORD

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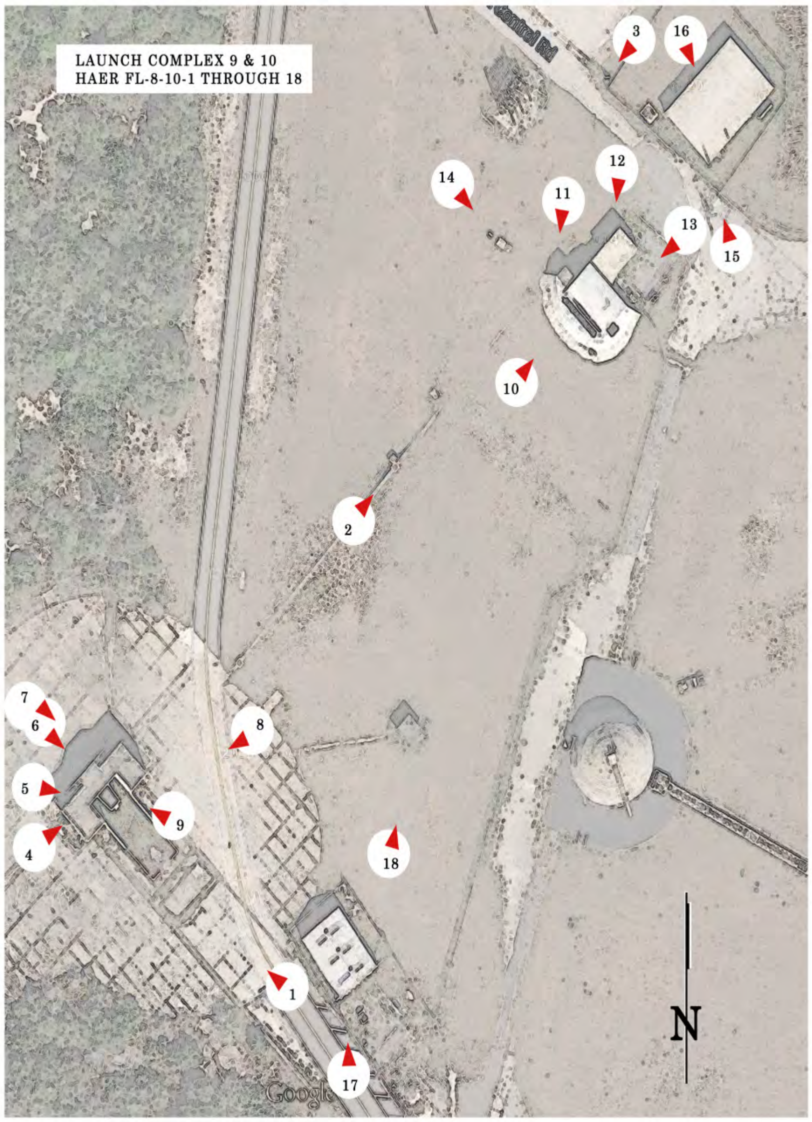
CAPE CANAVERAL AIR FORCE STATION, HAER No. FL-8-10-B
LAUNCH COMPLEX 9/10, FACILITY No. 17766
(LAUNCH COMPLEX 9/10, BLOCKHOUSE)
North side of Lighthouse Road, 0.9 miles north of Pier Road intersection
Cape Canaveral
Brevard County
Florida

INDEX TO BLACK AND WHITE PHOTOGRAPHS

Photographer: Martin Stupich, 2014
See photo key on page 2 of Index to Photographs

FL-8-10-B-1	GENERAL VIEW BLOCKHOUSE 9/10 (No. 17766), CURVED CONCRETE FACE, SHOWING CAST AND LIFT IMPRESSIONS, VIEW TO NORTHEAST (on photo key as #10)
FL-8-10-B-2	DETAIL, BLOCKHOUSE (No. 17766), CURVED CONCRETE SHIELD SHOWING CAST AND LIFT IMPRESSIONS, VIEW TO SOUTH (NOTE BEEHIVE BLOCKHOUSE LC 31 DISTANT RIGHT) (on photo key as #11)
FL-8-10-B-3	OBLIQUE GENERAL VIEW BLOCKHOUSE (No. 17766), VIEW TO SOUTH, MAINTENANCE SHOP (No. 17790) DISTANT RIGHT (on photo key as #12)
FL-8-10-B-4	OBLIQUE GENERAL VIEW BLOCKHOUSE (No. 17766), VIEW TO SOUTHWEST (on photo key as #13)
FL-8-10-B-5	SEPTIC TANK FACILITY (No. 17765); VIEW TO SOUTHEAST, BLOCKHOUSE (No. 17766) BEYOND (on photo key as #14)



Photograph Key for Entire Complex.

HISTORIC AMERICAN ENGINEERING RECORD
CAPE CANAVERAL AIR FORCE STATION
LAUNCH COMPLEX 9 AND 10
SEE INDEX TO PHOTOGRAPHS FOR CAPTION
HAER No. FL-8-10-B-1

HISTORIC AMERICAN ENGINEERING RECORD
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HISTORIC AMERICAN ENGINEERING RECORD
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LAUNCH COMPLEX 9 AND 10
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HISTORIC AMERICAN ENGINEERING RECORD
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HISTORIC AMERICAN ENGINEERING RECORD
CAPE CANAVERAL AIR FORCE STATION
LAUNCH COMPLEX 9 AND 10
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HAER No. FL-8-10-B-5

HISTORIC AMERICAN ENGINEERING RECORD

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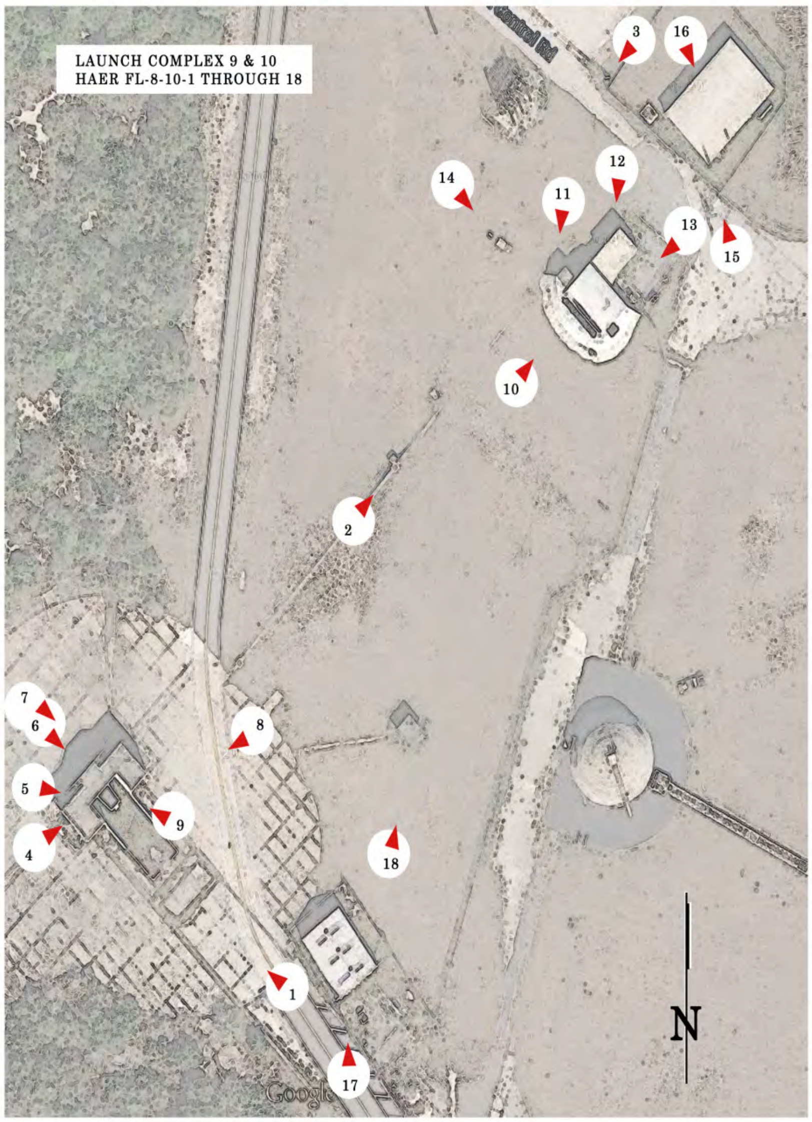
CAPE CANAVERAL AIR FORCE STATION, HAER No. FL-8-10-C
LAUNCH COMPLEX 9/10, FACILITY No. 17768
(LAUNCH COMPLEX 9/10, PUMP HOUSE AND RESERVOIR)
North side of Lighthouse Road, 0.9 miles north of Pier Road intersection
Cape Canaveral
Brevard County
Florida

INDEX TO BLACK AND WHITE PHOTOGRAPHS

Photographer: Martin Stupich, 2014
See photo key on page 2 of Index to Photographs

FL-8-10-15	PUMP HOUSE AND RESERVOIR (No. 17768) SOUTHWEST FACADE; VIEW TO NORTH (on photo key as #15)
FL-8-10-16	PUMP HOUSE AND RESERVOIR (No. 17768) NORTHWEST FACADE; VIEW TO SOUTHEAST (on photo key as #16)



Photograph Key for Entire Complex.

HISTORIC AMERICAN ENGINEERING RECORD
CAPE CANAVERAL AIR FORCE STATION
LAUNCH COMPLEX 9 AND 10
SEE INDEX TO PHOTOGRAPHS FOR CAPTION
HAER No. FL-8-10-C-1

HISTORIC AMERICAN ENGINEERING RECORD
CAPE CANAVERAL AIR FORCE STATION
LAUNCH COMPLEX 9 AND 10
SEE INDEX TO PHOTOGRAPHS FOR CAPTION
HAER No. FL-8-10-C-2

HISTORIC AMERICAN ENGINEERING RECORD

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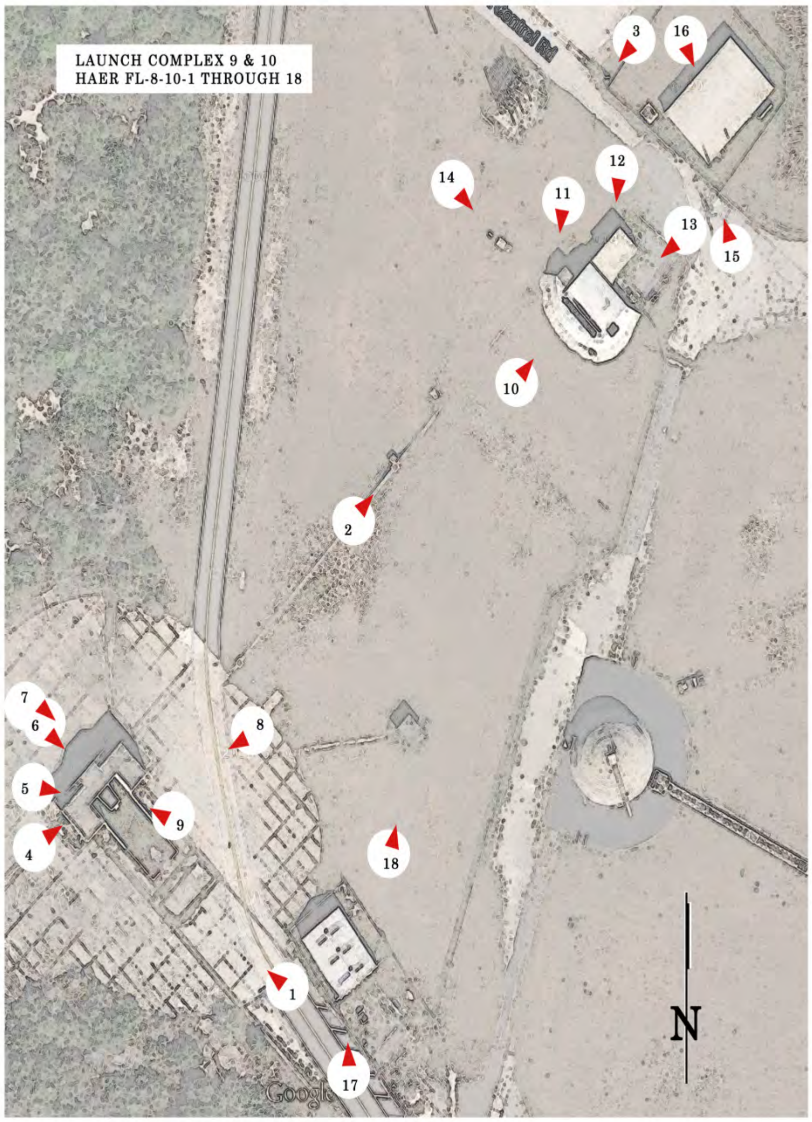
CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 9/10, FACILITY No. 17790 — HAER No. FL-8-10-D
(LAUNCH COMPLEX 9/10, MAINTENANCE SHOP)
North side of Lighthouse Road, 0.9 miles north of Pier Road intersection
Cape Canaveral
Brevard County
Florida

INDEX TO BLACK AND WHITE PHOTOGRAPHS

Photographer: Martin Stupich, 2014
See photo key on page 2 of Index to Photographs

FL-8-10-17	MAINTENANCE SHOP BUILDING (No. 17790); VIEW TO NORTH (on photo key as #17)



Photograph Key for Entire Complex.

HISTORIC AMERICAN ENGINEERING RECORD
CAPE CANAVERAL AIR FORCE STATION
LAUNCH COMPLEX 9 AND 10
SEE INDEX TO PHOTOGRAPHS FOR CAPTION
HAER No. FL-8-10-D-1

HISTORIC AMERICAN ENGINEERING RECORD

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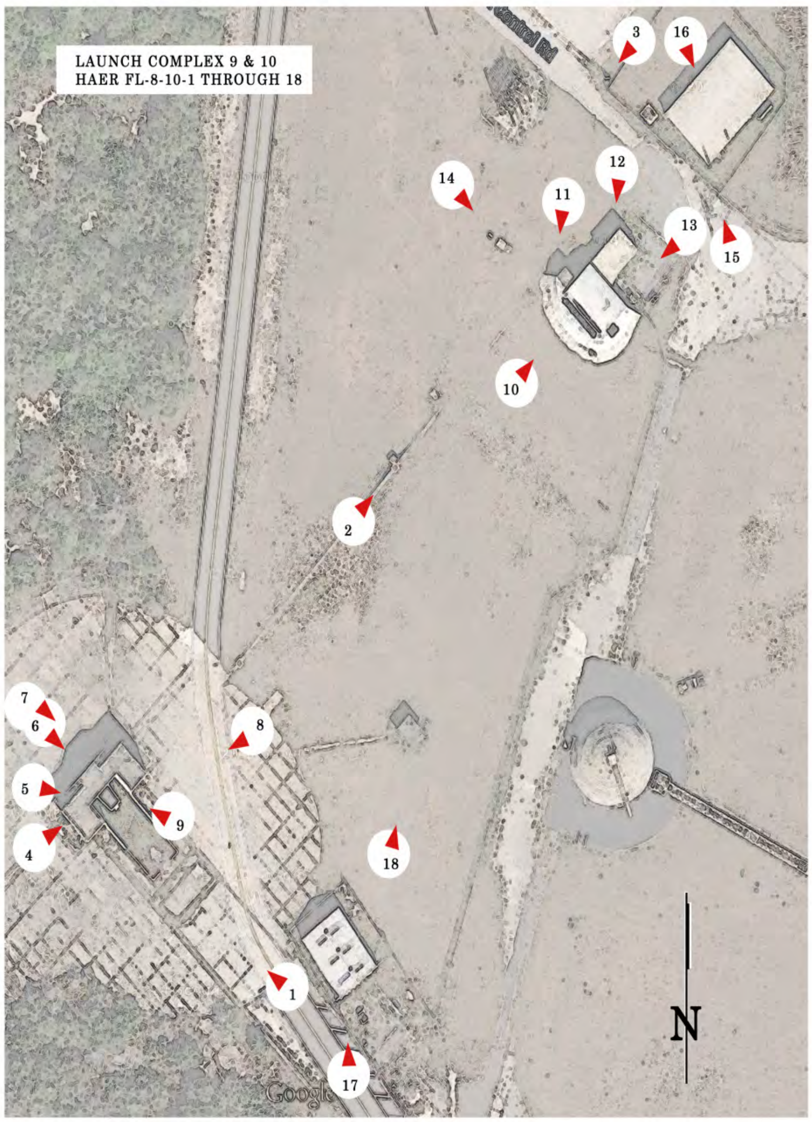
CAPE CANAVERAL AIR FORCE STATION, HAER No. FL-8-10-E
LAUNCH COMPLEX 9/10, FACILITY No. 17706
(LAUNCH COMPLEX 9/10, AIR CONDITIONING BUILDING)
North side of Lighthouse Road, 0.9 miles north of Pier Road intersection
Cape Canaveral
Brevard County
Florida

INDEX TO BLACK AND WHITE PHOTOGRAPHS

Photographer: Martin Stupich, 2014
See photo key on page 2 of Index to Photographs

FL-8-10-E-1	AIR CONDITIONING BUILDING (No. 17706); VIEW TO NORTH (on photo key as #18)



Photograph Key for Entire Complex.

HISTORIC AMERICAN ENGINEERING RECORD
CAPE CANAVERAL AIR FORCE STATION
LAUNCH COMPLEX 9 AND 10
SEE INDEX TO PHOTOGRAPHS FOR CAPTION
HAER No. FL-8-10-E-1

CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 14 — HAER No. FL-8-7

East side of ICBM Road
Cape Canaveral
Brevard County
Florida

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
Southeast Regional Office
National Park Service
U.S. Department of the Interior
100 Alabama Street, S.W.
Atlanta, GA 30303

HISTORIC AMERICAN ENGINEERING RECORD

CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 14

HAER No. FL-8-7

Location:	East side of ICBM Road, 1.3 miles north of intersection with Central Control Road Cape Canaveral Brevard County Florida USGS Cape Canaveral Quadrangle, Universal Transverse Mercator Coordinates: 17.544298.3151626
Date of Construction:	1956-1957
Engineer/Architect:	U.S. Army Corps of Engineers 1963 modifications by Maurice H. Connell & Associates, Inc., 1964 modifications by Pan American World Airways, Inc.
Present Owner:	United States Air Force (USAF)
Present Use:	Office and meeting space, vacant
Significance:	Constructed in 1956–1957, Launch Complex 14 at Cape Canaveral Air Force Station (CCAFS) was designed to support the Atlas missile program, the United States' first operational ICBM. Complex 14 was the site of the first Atlas launch in 1957. The complex was modified in 1959-1960 when it was assigned to Project Mercury, the United States' first effort to send a man into space. All four of the Project Mercury manned orbital flights were launched from Complex 14. At the close of Project Mercury in 1963, the complex was again modified for the Atlas-Agena configuration. Complex 14 was utilized to launch all of the unmanned Gemini Target Vehicles which NASA used to practice rendezvous and docking techniques during the Gemini Program between 1964 and 1966. The facility was deactivated in 1967 and abandoned in place in 1973.
Report Prepared by:	Kimberly Hinder Architectural Historian, Archaeological Consultants, Inc. 8110 Blaikie Court, Suite A, Sarasota, Florida 34240 Updated – Dr. Susan Enscore U.S. Army Engineer Research and Development Center Construction Engineering Research Laboratory 2902 Newmark Drive, Champaign, IL 61822
Date:	June 2003 (updated by Dr. Enscore February 2016)

HISTORICAL OVERVIEW OF CAPE CANAVERAL AIR FORCE STATION

Rocketry in the United States originated with the pioneering work of Robert H. Goddard, who launched the first liquid-propelled rocket in 1926. Across the Atlantic, German engineers were simultaneously developing their own rocket science program. Encouraged by the Nazi regime during World War II, the Germans developed the V-1 "buzz bomb" and the V-2 ballistic missiles which they used against Allied cities in 1944. Although the Allied forces had experimented with missiles powered by rocket engines, they lacked the technology to compete with the V-2 against which there was little defense. As a result, the U.S. Army, Navy, and Air Force (USAF) each initiated their own missile programs to fulfill their particular roles in national defense.

Following the war, the U.S. Army brought 115 German rocket engineers and scientists, including Dr. Wernher von Braun, to the United States to develop their program. These engineers conducted experiments to refine the German V-2 and develop long-range surface-to-surface guided missiles. Initially stationed at Fort Bliss, Texas, the team assisted the Army in testing rockets at the White Sands Proving Grounds beginning in May 1946. This site, however, was geographically constrained and posed a danger to civilians when rockets misfired.[1]

Increasingly concerned with Soviet missile and nuclear development after World War II, the Department of Defense created and charged the Committee on Long Range Proving Grounds to select a suitable missile test site in October 1946. Cape Canaveral was selected for several critical reasons. Missiles could be launched over the Atlantic Ocean and tracked from islands. The isolated location of the Cape enhanced security for research and development. The government already owned land at the Cape, and the undeveloped nature of the remaining land made it less expensive to acquire. The launch area was accessible via water easing the transportation logistics of heavy rockets and building supplies. The warm weather also allowed year round operation of a missile site at the Cape.[2]

In 1949, President Harry S. Truman signed legislation which established the Joint Long Range Proving Ground at Cape Canaveral, with Patrick Air Force Base (originally the Banana River Naval Air Station) selected as the support base. Although the entire facility was initially under

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[1] Charles D. Benson and William B. Faherty, *Moonport: A History of Apollo Launch Facilities and Operations* (National Aeronautics and Space Administration, Scientific and Technical Information Office, 1978; reprint as *Gateway to the Moon: Building the Kennedy Space Center Launch Complex* and *Moon Launch! A History of the Saturn-Apollo Launch Operations*, Gainesville: University Press of Florida, 2001), 1 (page references are to reprint edition).

[2] David Barton and Richard S. Levy, *An Architectural and Engineering Survey and Evaluation of Facilities at Cape Canaveral Air Force Station, Brevard County, Florida* (Resource Analysts, Inc., 16 March 1984), 3-4; Benson and Faherty, 4.

the cooperative use of the Army, Navy, and USAF, by a directive of the Department of Defense the USAF ultimately assumed responsibility for the range. The Joint Long Range Proving Ground was renamed the Air Force Missile Test Center, the first of many subsequent name changes. Although the Army continued its operation of the White Sands Proving Grounds in New Mexico and the Navy continued to fund its missile testing center at Point Mugu, California, both military branches continued to play an active role at Cape Canaveral.[3]

Construction and Missile Development at Cape Canaveral

Between April and June of 1950, land was acquired at the Cape through negotiation and condemnation proceedings. During this period, the United States Army Corps of Engineers was designated as the construction agency. The Jacksonville District of the Corps opened an office at Patrick Air Force Base in 1950 to oversee construction at Patrick Air Force Base and the Air Force Missile Test Center at Cape Canaveral. By December 1950, the office had managed $2.4 million of construction contracts. For each construction project, the agency (Army, Navy, or USAF) would submit project specifications, a deadline for completion, and authorization to begin construction to the Corps. The Corps would then negotiate and award a contract to an architectural/engineering firm for preparation of the construction plans. Once the plans were submitted, the Corps advertised and selected a contractor who was required to complete the project within the time frame or pay penalties.[4]

As the United States entered peacetime and reduced military funding during the late 1940s, the various branches of the military sought to determine their roles in missile research and design. The Army continued refining the German V-2, with the assistance of the team led by Wernher von Braun and 300 carloads of V-2 missile components seized during World War II. The Army conducted the first successful launch at Cape Canaveral on July 24, 1950. An Army–General Electric Corporation–California Institute of Technology team launched Bumper No. 8, a modified V-2 rocket, from Launch Pad 3. The Army team continued to use Pad 3 to conduct additional launches through 1951.[5]

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[3] E.R. Bramlitt, *History of Canaveral District 1950-1971*, (South Atlantic Division, US Army Corps of Engineers, 1971), 1–2; Benson & Faherty, 3, 7.

[4] Bramlitt, 1–2, 33.

[5] Benson and Faherty, 1, 6–7.

During the late 1940s and early 1950s, USAF activities at Cape Canaveral focused on winged cruise missile research and development as a deterrent force in the weapons race between the United States and the Soviet Union. Constrained by a reduced budget, the USAF chose to fund research and testing on the cruise missile, projected to be operational before the ten years anticipated for the development of the ballistic missile. These winged missiles resembled unmanned airplanes and fell into four different categories: air-to-air, air-to-surface, surface-to-air, and surface-to-surface. These missiles were restricted to the Earth's atmosphere because they required oxygen for engine combustion. The earliest launch pads, used for firing experimental winged missiles including the Lark, Matador, Snark, Bomarc, Bull Goose, and Mace, were located at the tip of the Cape, and included Launch Complexes 1-4, 9/10, and 21/22. Support buildings, including a communications building, a water plant, a fire fighting unit, electrical substations, a skid strip for the landing and reuse of the missiles, and Hangars C and O, were constructed near the original launch pads. As explosive power increased, and missiles necessarily grew larger, support activities were relocated farther from the launch pads to an Industrial Area which was situated along the western shore of the Cape.[6]

After the Soviets detonated their first atomic device in 1949, and following the outbreak of war in Korea in 1950, the United States government reassessed the military cutbacks of the late 1940s. With increased funding and the development of relatively lightweight nuclear warheads, the USAF and Army decided to pursue ballistic missile research and development. Faster and more accurate than the winged cruise missiles, ballistic missiles, with their own oxygen source, could leave the Earth's atmosphere. The ballistic missiles were divided into two categories based on the distance they could travel. The intercontinental ballistic missiles (ICBM) had a range of over 5,000 miles. Intermediate range ballistic missiles (IRBM) had a range of 1,500 miles. The USAF, which remained focused primarily on the development of cruise missiles, initiated a ballistic missile study which resulted in the Atlas missile.[7]

To advance its research and development of ballistic missiles, the Army Ballistic Missile Agency moved their team of German engineers from Fort Bliss, Texas, to the Redstone Arsenal in Huntsville, Alabama. Soon after the move to Huntsville, the launch team, known as the Missile Firing Laboratory (MFL), established facilities at Cape Canaveral. With the first launch of the Redstone missile on August 20, 1953 at Launch Pad 4, the MFL inaugurated the testing of

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[6] Barton and Levy, 6, 25; Bramlitt, 5–8; Jacob Neufeld, *The Development of Ballistic Missiles in the United States Air Force, 1945–1960*, (Washington, D.C.: Office of Air Force History, United States Air Force, 1990), 239.

[7] Neufeld, 98, 241; Benson and Faherty, 1, 3, 7.

ballistic missiles, an event which foreshadowed the construction of numerous launch facilities for ballistic missiles at the Cape.[8]

Both the detonation of the first thermonuclear device in 1952 and intelligence reports indicating that the Soviet Union was developing long-range missiles and thermonuclear warheads led to advancements in ballistic missile development. In 1953, the USAF formed a panel of U.S. scientists to examine their Snark, Navaho, and Atlas missile programs. The panel recommended accelerating development of the Atlas ICBM.[9] By 1955, USAF officials convinced President Eisenhower to assign the ICBM development program the highest national priority. Accordingly, the USAF initiated programs for the design and testing of the ICBM Titan in 1955 and the ICBM Minuteman in 1958. As the USAF ICBM program grew, intelligence reports indicated that the Soviet Union would have ICBMs with nuclear warheads operational by 1960. Fearing that the United States could not match the Soviet ICBM threat, the Department of Defense decided to fund the development of IRBMs because they would be operational sooner and would act as a deterrent based out of Europe. In 1955, the Department of Defense approved two IRBM programs, the USAF Thor and the Army/Navy Jupiter, which developed simultaneously and were assigned an equal national priority as the ICBM programs.[10]

The constant drive to develop more accurate and powerful weapons during the Cold War led to the construction of numerous launch complexes along the Cape. Although many of the early launch complexes were adapted to new uses as support structures, complexes constructed for one type of missile were rarely reused to launch another type of missile because they were not configured structurally, electronically, or for safety concerns for the new larger and more powerful missile. Economically, it was more cost effective to design and build a new complex than to reconfigure and adapt an old complex. Explosive hazards, the dangers of launching over other complexes or inhabited areas, and maintaining a line of site between the launch vehicle and the launch control center (blockhouse) determined the choice of sites and distance between launch complexes. Each missile had similar ground requirements at the launch complex including a launch pad, a gantry service tower, a blockhouse for on-site command and control of

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[8] Benson and Faherty, 1, 3, 7.

[9] Neufeld, 98–103; David N. Spires, "The Air Force and Military Space Missions: The Critical Years, 1957-1961," in *The U.S. Air Force in Space: 1945 to the 21st Century*, Proceedings Air Force Historical Foundation Symposium, Andrews AFB, Maryland, September 21-22, 1995, ed. R. Cargill Hall and Jacob Neufeld (Washington, DC: USAF History and Museums Program, United States Air Force, 1998), 34–35.

[10] ibid., 143-48, 241–242.

the launch, and a network of power, fuel, and communication links.[11] The government maintained programs for both ICBMs and IRBMs concurrently and facilities for both types of missiles were constructed at Cape Canaveral. Over time, the area south of the tip was developed for launching IRBMs (Redstone, Pershing, Polaris/Poseidon, and Thor) and included launch complexes 5/6, 17, 18, 25, 26, 29, and 30). The area north of the tip was developed for launching ICBMs and space launch vehicles (Atlas, Titan, Saturn) and included Launch Complexes 11–16, 19, 20, 34, 36, and 37.[12]

Throughout the early and mid-1950s, the focus of activities at Cape Canaveral remained on missile development for defense against the Soviets. In November 1956, the Secretary of Defense divided the responsibilities for research and development of missiles among the armed forces. The USAF received responsibility for all intermediate and long-range missiles, both IRBMs and ICBMs, while the Army was restricted to missiles with a range of 200 miles or less. The Navy was limited to developing submarine and ship-based IRBM missile systems.[13]

Cape Canaveral and the United States Space Program

In 1955, President Eisenhower announced that the United States would launch an unmanned satellite as part of the nation's participation in the International Geophysical Year which extended from July 1957 through December 1958. The Army, Navy, and USAF immediately initiated planning for their own satellite programs.[14] When the Soviets launched the satellite Sputnik I in October of 1957, the attention of the public turned to space exploration. The following month, the Soviets placed the Sputnik II satellite carrying a dog into orbit around the Earth. The launch caused a furor among Americans who feared that the U.S. was losing not only the "space race," but also that a "missile gap" existed between the U.S. and the Soviets, who it was believed had hundreds of operational ICBMs. The President initially assigned responsibility for the U.S. space program to the Department of Defense. The Army's Development Operations Division led by

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[11] Benson and Faherty, 8–10.

[12] Barton and Levy, 4, 9; Denise P. Messick, Cynthia G. Rhodes, and Charles E. Cantley, *45th Space Wing Cultural Resource Management Plan*, Technical Report No. 386 (Stone Mountain, Georgia: New South Associates, 1996), 95; James N. Gibson, *Nuclear Weapons of the United States: An Illustrated History* (Atglen, PA: Schiffer Publishing, Ltd., 2000); Hartmann 2003.

[13] Neufeld, 242; Barton and Levy, 17.

[14] R. Cargill Hall, "Civil-Military Relations in America's Early Space Program," in *The U.S. Air Force in Space: 1945 to the 21st Century*, Proceedings Air Force Historical Foundation Symposium, Andrews AFB, Maryland, September 21-22, 1995, ed. R. Cargill Hall and Jacob Neufeld (Washington, DC: USAF History and Museums Program, United States Air Force, 1998), 25.

Wernher von Braun shifted their focus to the use of missiles to propel payloads, or even a man, into space.[15] After several failures on the launch pad, the United States entered the space race with the launch of the Army's scientific satellite Explorer I on January 31, 1958 using a four stage Jupiter C missile named Juno I. With the threat of a growing fleet of operational Soviet ICBMs, the branches of the U.S. military initiated the development of photographic reconnaissance satellites which were operational by 1960.[16]

Realizing that the military's involvement in the space program would jeopardize the goal of using space for peaceful purposes, the President's Science Advisory Committee urged that a centralized agency be created to oversee the scientific exploration of space. The new agency, the National Aeronautics and Space Administration (NASA), established October 1, 1958, was to be a civilian agency with the mission of carrying out scientific aeronautical and space exploration, both manned and unmanned. The Department of Defense, especially the USAF, would continue with defense related missile and satellite development.[17] Soon after the creation of NASA, Navy personnel and facilities associated with Project Vanguard and over 400 scientists from the Naval Research Laboratory were reassigned to NASA. The California Institute of Technology's Jet Propulsion Laboratory, affiliated with the Army, was also transferred to NASA. Initially working with NASA as part of a cooperative agreement, President Eisenhower officially transferred a large portion of the Army's Development Operations Division with the team led by Wernher von Braun to NASA in March 1960. At the same time, Eisenhower named the Huntsville NASA installation the Marshall Space Flight Center, and designated the MFL at Cape Canaveral as the Launch Operations Directorate of NASA. The Launch Operations Directorate, led by Dr. Kurt Debus, managed the overall integration, testing, and the launch operations of NASA.[18]

NASA soon organized a National Launch Vehicle Program to identify and analyze which missiles would be the most effective in exploring space. As a result, the Scout, Thor-Delta, Atlas, Titan, and Saturn, and modified versions of these rockets, were selected as boosters for manned and unmanned missions. Unmanned activities have included suborbital, orbital, and lunar satellite and vehicular missions to gather scientific information often relating to physics and

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[15] Benson and Faherty, 1–2.

[16] ibid.

[17] Hall, 30; Barton and Levy, 20; Spires, 39.

[18] Spires, 39; Benson and Faherty, 15.

astronomy. Although some were conducted to prepare for manned launches, most of the missions were intended simply to gain scientific knowledge with which to better understand Earth.[19]

Already upstaged by the Soviets, one of NASA's first goals was to put a man in orbit around the Earth. At its creation, the USAF's manned space projects were transferred to NASA, which NASA combined under the name Project Mercury in December 1958. NASA selected the first seven astronauts for the manned space program in April 1959. The goals of Project Mercury included sending a man into space to orbit the Earth, testing his ability to perform in a weightless environment, and to recover both man and capsule.[20] The program included two manned suborbital flights powered by a modified Redstone missile and four manned orbital flights powered by an Atlas missile topped by the Mercury capsule. The first suborbital flight occurred on January 31, 1961 with the launch of Ham, a chimpanzee. The United States was again upstaged when the Soviet Union launched Vostock I with cosmonaut Uri Gagarin to orbit the Earth in April 1961. The launch of Alan Shepard the following month on a Mercury suborbital flight proved anticlimactic.[21]

Realizing the impact of the Soviet advancements on the American psyche, President John F. Kennedy appointed Vice President Lyndon Johnson, in cooperation with representatives from NASA and the associated industries, to develop a space program that would surpass the Soviet program. The panel recommended a ten-year phased approach which would include manned space flight, planetary exploration, and the development of new rockets and satellites. Accepting the recommendations, President Kennedy presented the following before a joint session of Congress on May 25, 1961:

> I believe this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the Moon and returning him safely to the Earth. No single space project in this period will be more impressive to mankind, or more important for the long-range exploration of space, and none will be so difficult or expensive to accomplish.[22]

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[19] Barton and Levy, 20–27.

[20] Spires, 39; *Exploring Space...Project Mercury* (U.S. National Aeronautics and Space Administration) 3, Kennedy Space Center Archives, Kennedy Space Center, Sweetsir Collection 95-15, Box 12.

[21] Harry Butowsky, "Man in Space (Reconnaissance Survey) 1903–1981," (Denver: National Park Service, 1981), 4.

[22] ibid., "Man in Space," 4–5.

With widespread support, the public and Congress embraced the goal and the program proceeded rapidly. Circling the Earth three times, John Glenn completed the first manned orbital flight of the United States on February 20, 1962 in a capsule propelled by an Atlas rocket from Launch Complex 14. Followed by three more manned orbital flights, the Mercury program concluded as a success on May 15, 1963.[23]

NASA initiated planning for Project Gemini in late 1961 as the intermediate step in sending a man to the moon. Officially announced in 1962, the project was operational by 1964. The goals of Project Gemini included testing man's performance during extended periods in space, both within and outside of the spacecraft, development of rendezvous and docking techniques, and perfection of controlled reentry and landing techniques. The larger, more maneuverable capsule, designed to hold two men, was propelled by a Titan II rocket. Following the first unmanned Gemini launch on April 8, 1964, Gemini 3 was the first manned flight of the program in March 1965. Gemini 12, launched in November 1966, successfully completed the program.[24]

Apollo, the final step in landing astronauts on the moon, immediately followed Project Gemini. Studies to build the Saturn rocket, which would propel man to the moon, actually started in 1957 with the team led by Wernher von Braun under the Army's jurisdiction.[25] Ten times more powerful than the Atlas rocket and twenty times more powerful than the Jupiter, the size and power of the Saturn required the construction of Launch Complexes 34 and 37 at Cape Canaveral. Test flights of the Saturn rocket started at Launch Complex 34 in October 1961. In January 1962, NASA announced that the Saturn would be the moon launch vehicle. The goal of Apollo was to launch a team of three astronauts into orbit around the moon. While one astronaut remained in orbit, the other two would then take an attached spacecraft to land on the moon and then redock with the primary vessel before returning to Earth. The initial missions were Earth orbital (unmanned and manned) followed by lunar missions to orbit and, later, land on the moon.[26]

NASA utilized Launch Complexes 34 and 37 for research and development of the Saturn rocket. Continued modifications to the Saturn to increase its power to propel man to the moon led to a

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[23] Barton and Levy, 28.

[24] Ibid., 28-30; William A. Lockyer, Jr., *A Summary of Major NASA Launchings: October 1, 1958-September 30, 1973,* KSC Historical Report No. 1 (John F. Kennedy Space Center: KSC Historical Services, 1973), IX-1-8.

[25] Benson and Faherty, 1-2.

[26] ibid., 37, 60–64; Barton and Levy, 30–31.

larger rocket with new blast and acoustic hazards. With these factors in mind, combined with the stepped-up launch schedule necessary to land a man on the moon by the end of the decade, it was apparent by 1961 that the Apollo program required a new launch complex.[27] Cape Canaveral, with over 22 launch complexes, did not have room for another complex. NASA officials solved the dilemma by acquiring land on Merritt Island, west and north of the existing missile launching area at the Cape. The first acquisitions of land started in 1962, with the majority under federal ownership by 1964. Initially known as the Merritt Island Launch Area, the land was acquired for use predominantly in support of the Manned Lunar Landing Program (Apollo) and was placed under NASA's exclusive jurisdiction. With the new facilities, NASA's offices at the Cape, led by Kurt Debus, expanded and relocated to the Merritt Island Launch Area. The newly independent installation, on par with Marshall Space Flight Center, was renamed the John F. Kennedy Space Center in November 1963 after the death of the president.[28]

During land acquisition and construction of the Kennedy Space Center, NASA continued manned space flight under the Mercury and Gemini programs and preparations for Apollo. During a simulation flight at Launch Complex 34, three astronauts, Virgil Grissom, Edward White, and Roger Chaffee, lost their lives in an oxygen fire in the cockpit on January 27, 1967. Apollo 4 (November 9, 1967) through Apollo 6 (April 4, 1968) were unmanned Earth orbital missions to test the Saturn rocket and the Command and Service modules. The October 11, 1968 Apollo 7 launch was the first manned Apollo launch which placed astronauts into Earth's orbit for a ten-day mission. Apollo 8, the first launch at the newly completed Kennedy Space Center, achieved the first lunar orbit in December 1968. The goal of landing man on the moon was achieved with Apollo 11 on July 20, 1969 and was followed by six additional lunar missions which gathered extensive scientific information culminating in Apollo 17 in December 1972. Subsequent manned space programs included the Skylab, Apollo-Soyuz, and the Space Shuttle, which took its inaugural flight on April 12, 1981. The Space Shuttle program ended on July 21, 2011.[29]

History of Complex 14

As the first of four launch complexes constructed at Cape Canaveral to serve the Atlas ballistic missile program, Launch Complex 14 played a significant role in closing the perceived "missile

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[27] Benson and Faherty, 65–68.

[28] ibid., 96-98, 105, 133–137, 146–48.

[29] Barton and Levy, 31; Butowsky "Man in Space," 5–6.

gap" of the Cold War with more than a dozen launches testing the United States' first ICBM missile. The arms race between the United States and the Soviet Union to develop more powerful and accurate weapons was a defining feature of the Cold War era. After the Atlas missile was declared operational, Launch Complex 14 proved pivotal in the development of the United States' manned space program through the Mercury and Gemini programs. From 1957 to 1966, the USAF and NASA launched 32 Atlas missiles and space launch vehicles in a variety of configurations from Launch Complex 14.

Launch Complex 14 was one of four complexes constructed for the Atlas ballistic missile program, the first U.S. ICBM. The Atlas originated in October 1945, when the U.S. Army Air Technical Service Command solicited proposals on the design of an unmanned vehicle capable of carrying a weapons payload 20 to 5,000 miles. Consolidated Vultee Aircraft Corporation (Convair) of San Diego, California, submitted several designs for consideration. In January 1946, the USAF awarded Convair a contract to begin preliminary design work on a missile capable of delivering a weapons payload of 6,000 miles or greater. In April 1946, the company received approximately $2 million to build ten missiles for flight testing under the MX-774 "Hiroc" (High-Altitude Rocket) designation. Although design work was initiated in June 1946, the program was canceled by the USAF in July 1947. As the United States entered peacetime and reduced military spending during the late 1940s, the USAF chose to fund research and testing on the cruise missile, projected to be operational before the ten years anticipated for the development of an operational ballistic missile.[30]

Although the program was cancelled, some of the funding for the MX-774 remained available and Convair was given permission to build and test-launch three of the ten missiles originally authorized. The first missile was completed in October 1947 with test firings conducted at Convair's Ft. Loma facility between November 1947 and May 1948. The first MX-774 was launched at the White Sands Missile Range on July 13, 1948. The second and third MX-774 missiles were launched in September and December 1948. Despite the conclusion of the MX-774 project, Convair continued ballistic missile research and design work without USAF funding. Convair and its associates developed several innovations which would carry through to the Atlas missile, including the "one-and-one-half stage" propulsion system, single-wall stainless steel construction, a separating nose cone, and a gimbaled engine exhaust nozzle.[31]

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[30] Neufeld, 239; Clifford J. Lethbridge, "Atlas Program Background," Spaceline.org, Spaceline, Inc., 1998.
[31] Lethbridge, "Atlas Program Background"; Neufeld, 241.

Following the detonation of the first Soviet atomic device in 1949 and the outbreak of war in Korea in 1950, the United States government reassessed the military cutbacks of the late 1940s. With increased funding, the USAF decided to again pursue ballistic missile research and development. On January 23, 1951, the USAF awarded Convair a long-range missile study contract designated MX-1593. Convair already had detailed ballistic missile design proposals which had been refined in-house following the conclusion of MX-774. The company submitted design proposals for both pure ballistic and semi-ballistic concepts, for which Convair engineer Karel J. Bossart proposed the name “Atlas,” perhaps referring to Greek mythology or in honor of the Atlas Corporation, the parent company of Convair. The USAF approved of the Atlas name in August 1951, and concluded in September 1951 that Convair’s pure ballistic missile approach would be the best choice for an ICBM. The USAF authorized the continued development of the Atlas, but funding remained at lower levels than for the Snark and Navaho cruise missile programs.[32]

Both the detonation of the first thermonuclear device in 1952 and intelligence reports indicating that the Soviet Union was developing long-range missiles and thermonuclear warheads led to advancements in ballistic missile development. In May 1953, Convair received approval from the USAF to develop two series of Atlas test missiles, the first designated X-11 and the second designated X-12. Modifications to the missile’s design, including a reduction in size with smaller nuclear weapons payloads, continued in 1953 and 1954. In October 1953, the USAF formed a panel of U.S. scientists to examine their Snark, Navaho, and Atlas missile programs. The panel, officially known as the Strategic Missiles Evaluation Group and unofficially as the Teapot Committee, recommended accelerating development of the Atlas ICBM.[33]

In the spring of 1954, the USAF accelerated the Atlas program and gave it the highest developmental priority with the goal of reaching operational status by June 1958. In December 1954, the USAF and Convair publicly announced that Atlas production was underway. After a series of intensive inspections, the USAF issued Convair a contract for the long-term continuation of the Atlas program on January 14, 1955. Convair received approval from the USAF for the construction of the first operational test missiles in mid-1955. The first completed missile, intended for static systems testing in California, was delivered in August 1956. In

[32] ibid.
[33] Neufeld, 98-103; Spires, 34-35.

October, a “dummy” missile arrived at Cape Canaveral to test the compatibility of the Atlas body with launch systems. The first flight-ready Atlas arrived at Cape Canaveral in December 1956. [34]

Launch Complexes 11, 12, 13, and 14 were constructed for the USAF’s Atlas ballistic missile program between January 1956 and August 1957 (Figure 1). As the construction agency for the USAF at Cape Canaveral, the U.S. Army Corps of Engineers initiated construction on Complex 14 in March 1956. The initial construction costs for the “brick and mortar” totaled $4,308,000. Although the complex reached “beneficial occupancy” status in January 1957, the plans and completed construction were officially approved by the Corps in August 1957. Complex 14 was the first of the four Atlas complexes completed, with the first launch of an Atlas missile at Cape Canaveral on June 11, 1957.[35]

Utilizing the Atlas A, Atlas B, Atlas D, Atlas-Able, Atlas-Agena A, Atlas-Agena D, and Mercury-Atlas configurations, Complex 14 supported 32 launches of the Atlas missile, including the four manned Mercury missions. Originating as the X-11, the first missile launch at Complex 14 was part of the Atlas A series. Because the intent of the Atlas A prototype was to test the airframe and propulsion system of the Atlas, testing of the missile required a relatively short range of only 600 miles. The first missile launched on June 11, 1957 was destroyed by the Range Safety Officer after less than one minute into its flight when it strayed off of its intended course. Of the eight Atlas A missiles launched at Cape Canaveral, five of them were launched from Complex 14. Only three of the eight missiles completed their planned flight, but these tests provided sufficient information to determine that the Atlas airframe was strong enough to withstand low-altitude air, and that the launch system and gimbaled engine flight control system worked effectively. These initial launches of the Atlas, completed with the final launch of an Atlas A on June 3, 1958, occurred under the auspices of the USAF.[36]

Despite the high priority placed on the Atlas program, the Eisenhower Administration reduced its budget in 1956 and had planned further cuts for fiscal year 1958 when the Soviets launched Sputnik I in October of 1957. Public outcry of a “missile gap” between the Soviets and the U.S. prompted the Administration to reverse its budget cuts and again accelerate the USAF’s ICBM

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[34] Neufeld, 241-242; Lethbridge, “Atlas Program Background.”

[35] Real Property Cards, Cape Canaveral Air Force Station; Eastern Test Range Launch Complexes, 1991; Cleary, *Eastern Range Launches*; Cleary, “45th Space Wing.”

[36] Clifford J. Lethbridge, “Cape Canaveral Rocket and Missile Box Scores”; Clifford J. Lethbridge, “Atlas A Fact Sheet,” Spaceline.org, Spaceline, Inc., 2001; Cleary, *Eastern Range Launches*.

program.[37] Originating as the X-12, the second Atlas prototype, the B series, was designed to test booster and nose cone separation as well as the overall propulsion system. This required a long range flight of 6,000 miles and a one-and-one-half stage booster/sustainer engine combination. The first of nine Atlas B launches occurred on July 19, 1958. Of the three Atlas B missiles launched from Complex 14, the second, launched on November 28, 1958, was the first successful full-range test flight of 6,000 miles. After nine launches, the final Atlas B launch completed the testing of this prototype on February 4, 1959.[38]

Initially a prototype, the Atlas D was designed to test all of the Atlas operating systems and was the first fully operational Atlas missile. Due to the "missile gap" perception, the USAF initiated construction of operational Atlas launch sites even before the first test flight of the Atlas D in order to accelerate the time frame in which the ICBM could be deployed in an operational mode. With a range of 10,360 miles, test flights for the Atlas D were designed to simulate operational conditions of a deployed and activated ICBM. The first three launches of the Atlas D, occurring between April and June 1959, exploded less than three minutes into flight. The fourth test flight, launched on July 28, 1959, was a success and led to the USAF declaring the Atlas an operational missile on September 9, 1959 after which missiles were deployed to various USAF bases across the United States. Although declared operational in 1959, testing of the Atlas D continued through January 1961 with 33 completed test flights.[39]

Soon after the creation of NASA in October 1958, one of the organization's initial unmanned scientific efforts involved plans to explore the moon. The Pioneer Program consisted of a lunar satellite or probe as a payload launched by an Atlas-Able combination. The Atlas-Able was a four-stage rocket utilizing the Atlas D as the first stage and Able upper stages adapted from the Vanguard (Navy) rocket program. The Atlas-Able was designed to carry a 1,500-pound payload to low-Earth orbit, a 500-pound payload to lunar impact, or a 300-pound payload to Earth-escape trajectory. In an attempt to send the lunar probe Pioneer to the moon, the first Atlas-Able launch occurred on November 26, 1959 from Complex 14. The first launch failed when the shroud covering the payload detached prematurely forty-five seconds into the launch. The second effort of the Pioneer program exploded during static firing. When this loss was followed by two

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[37] Neufeld, 241–242.

[38] Clifford J. Lethbridge, "Atlas-B Fact Sheet"; Lethbridge, "Cape Canaveral Rocket and Missile Box Scores"; Cleary, *Eastern Range Launches*.

[39] Clifford J. Lethbridge, "Atlas-D Fact Sheet," Spaceline.org, Spaceline, Inc., 2001; Lethbridge, "Cape Canaveral Rocket and Missile Box Scores."

additional unsuccessful launches, testing of the combination was discontinued in December 1960.[40]

As part of the missile defense program, the USAF tested the Atlas-Agena A configuration early in 1960. The Atlas-Agena A consisted of the combination of an Atlas D missile as a first stage and the Lockheed Agena A as a second stage. Capable of projecting a 5,000-pound payload into low-Earth orbit, the vehicle was used as part of the Missile Defense Alarm System (MIDAS) program to launch early warning satellites. The satellites of the MIDAS program were designed to utilize infrared sensors to detect missile plumes and provide an early warning of a ballistic missile attack. Using the Atlas-Agena A configuration, the USAF launched two MIDAS satellites into orbit in February and May of 1960 from Launch Complex 14 (Figure 2). Following the final MIDAS launch at Complex 14 in May of 1960, additional MIDAS launches were conducted from Vandenberg Air Force Base. Because the Atlas-Agena A had to be individually manufactured for each launch, the cost was prohibitive and production of the vehicle was discontinued.[41]

Soon after the organization of NASA in October 1958, the agency organized a National Launch Vehicle Program to identify and analyze which missiles would be the most effective in exploring space. Due to its reliability and versatility, the Atlas was one of the missiles selected as the core booster for space launch vehicles. Although Atlas-D based space launch vehicles were classified as Space Launch Vehicle-3 (SLV-3), the projects were also known by the name combination of the missile and associated upper stages or mission assignments.[42] As NASA was charged with the mission of carrying out manned and unmanned scientific aeronautical and space exploration, the USAF's manned space projects were soon transferred to the new agency, which NASA combined under the name Project Mercury in December 1958. The USAF provided NASA facilities at Cape Canaveral, including space at Complex 14, in order to continue the development and implementation of Project Mercury.[43] The goals of Project Mercury included sending a man into space to orbit the Earth, testing his ability to perform in a weightless

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[40] Clifford J. Lethbridge, "Atlas-Able Fact Sheet," Spaceline.org, Spaceline, Inc., 1998; Mark Wade, "Atlas Able," astronautix.com/lvs/atlas able.html, SpaceBank.com, 2002.

[41] Clifford J. Lethbridge, "Atlas-Agena A Fact Sheet," Spaceline.org, Spaceline, Inc., 1998; Lethbridge, "Cape Canaveral Rocket and Missile Box Scores"; Cleary, *Eastern Range Launches*; Butowsky, *National Register Nomination*, 7:7–11; Cleary, *The 6555th Missile and Space Launches Through 1970,* 158–161.

[42] Lethbridge, "Atlas D Fact Sheet"; Barton and Levy, 20-27.

[43] Spires, 39.

environment, and to recover both man and capsule. NASA selected the first seven astronauts for the manned space program in April 1959.[44]

The Mercury program consisted of a two-pronged approach which first involved sending a man on suborbital flights followed by orbital flights around the Earth. Although NASA launched a number of test flights, the official Mercury flights included two manned suborbital flights powered by a modified Redstone missile and four manned orbital flights powered by an Atlas missile topped by the Mercury capsule. NASA initiated testing of the Atlas configuration topped by a Mercury test capsule from Complex 14 on September 9, 1959. The capsule reached an altitude of 100 miles and was recovered after reentry. Throughout 1960, the USAF continued testing the Atlas D missile at Complex 14, while NASA tested the Mercury production capsule from the complex in July 1960. In November and December 1960, NASA focused on testing the Redstone missile configuration for suborbital flights from Launch Pad 5. The first suborbital flight occurred on January 31, 1961 with the launch of Ham, a chimpanzee, from Launch Pad 5.[45]

Although the Soviet Union launched their first manned orbital flight in April 1961, the United States soon followed. Continued testing of the Redstone configuration led to the first U.S. suborbital flight manned by astronaut Alan Shepard, Jr. on May 5, 1961 from Launch Pad 5.[46] The second manned suborbital flight on July 21 completed the suborbital phase of Project Mercury. While progress continued on the suborbital phase of the project early in 1961, NASA also continued testing the Atlas-Mercury capsule configuration exclusively utilizing Complex 14 for this purpose. Launches in February and April 1961, led to the first successful orbital flight of the capsule in September 1961 (Figure 3). On November 29, 1961, a capsule, carrying the chimpanzee Enos, successfully orbited the Earth twice. Circling the Earth three times, John Glenn completed the first manned orbital flight of the United States on February 20, 1962 in a capsule propelled by an Atlas rocket from Launch Complex 14. Glenn was followed by three more manned orbital flights, all launched from Complex 14. On May 24, 1962, M. Scott Carpenter orbited the earth three times, and was succeeded by Walter M. Schirra, Jr. who orbited

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[44] Spires, 39; *Exploring Space…Project Mercury*.
[45] Lockyer, VIII-1-2; Cleary, *Eastern Range Launches*.
[46] Butowsky, "Man in Space," 4; Lockyer, VII-3.

the earth nearly six times. After 22 orbits, the flight of L. Gordon Cooper brought a successful conclusion to the Mercury program on May 15, 1963.[47]

As the intermediate step in sending a man to the moon, NASA initiated planning for Project Gemini in late 1961. Officially announced in 1962, the project was operational by 1964. The goals of Project Gemini included testing man's performance during extended periods in space, both within and outside of the spacecraft, development of rendezvous and docking techniques, and perfection of controlled reentry and landing techniques. The larger, more maneuverable capsule, designed to hold two men, was propelled by a Titan II rocket and launched from Complex 19. Following the first unmanned Gemini launch on April 8, 1964, Gemini 3 was the first manned flight of the program in March 1965.[48]

Complex 14 was utilized to launch all of the unmanned Gemini Target Vehicles which the astronauts used to practice rendezvous and docking techniques. At the close of the Mercury program, Launch Complex 14 was modified in 1963 and 1964 to launch the Atlas-Agena D, an improved version of the Atlas-Agena A. At that time, a set of "as-built" drawings of the complex were prepared by the As-Built Section of the Facilities Engineering Department in the Guided Missiles Range Division of Pan American World Airways, Inc. and Maurice H. Connell & Associates, Inc. of Miami. The Atlas-Agena D consisted of the combination of an Atlas E or F missile (essentially an upgraded Atlas D) as a first stage and the Lockheed Agena D as a second stage. The Agena D stage was modified to serve as a docking target. The first Atlas-Agena launch on October 25, 1965 disintegrated at the time of ignition of the main Agena engine. The second Target Vehicle launch on March 16, 1966 proved a success when the astronauts of Gemini 8 rendezvoused with the vehicle. Target Vehicles were utilized to practice rendezvous and docking procedures for the Gemini 9, 10, 11, and 12 missions (Figure 4). Gemini 12, launched in November 1966, successfully completed the program. All of the seven Gemini Target Vehicles were launched from Complex 14 with the final Gemini Target Vehicle Launch on November 11, 1966 serving as the final launch from the complex.[49]

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[47] Lockyer, VII-2-7; Barton and Levy, 28; Cleary, *Eastern Range Launches*.

[48] Barton and Levy, 28-30; Lockyer, IX-1-8.

[49] Cleary, *Eastern Range Launches*; Lockyer, IX-1-8; Clifford J. Lethbridge, "Atlas-Agena D Fact Sheet," Spaceline.org, Spaceline, Inc., 1998; Clifford J. Lethbridge, "Atlas-Agena A Fact Sheet"; Clifford J. Lethbridge, "Atlas E Fact Sheet," Spaceline.org, Spaceline, Inc., 2001; Clifford J. Lethbridge, "Atlas F Fact Sheet," Spaceline.org, Spaceline, Inc., 2001; Pan American World Airways, Inc., Drawings 01-01684-005, 01-01684-031, 01-01684-032, 01-01684-033, 01-01684-036, 01-01684-037, 01-01684-040, 01-01684-041, 01-01684-116, 01-01684-117, and 01-01684-118; Maurice H. Connell & Associates, Inc., Drawing 01-01684-197.

Launch Complex 14 was deactivated in 1967 and abandoned in place October 31, 1973. The Service Structure, Umbilical Mast, and northern portion of the Launch Stand were razed in December 1976 due to excessive rust and deterioration (Figure 5). Launch Complex 14 was listed as part of the Cape Canaveral Air Force Station National Historic Landmark District on April 16, 1984. The Blockhouse (Facility No. 10905) was restored and converted to meeting space in 1998 to commemorate the 35th Anniversary of the final Mercury flight. The Ready Building (former Facility No. 10911) was converted to offices for contract personnel before being demolished.[50] Overall, the Launch Stand, Umbilical Mast, Service Structure, Water Storage Tank, original Sentry House, the Ready Building, the Hazard Storage Shelter, the Liquid Oxygen (LOX) tank, the Cable Tray System, and the JP-4 storage and transfer machinery have been removed, along with smaller elements such as diesel tanks, tracking equipment, and cameras. The Flume and Skimming Basin (Facility No. 1684P), Water Demineralization Station (Facility No. 10915), Subcable Hut and Vault (Facility No. 10907), the Blockhouse (Facility No. 10905), the Launch Ramp (Facility No. 1684B), JP-4 Area and Blast Wall (Facility No. 1684H), the Liquid Oxygen/Gaseous Nitrogen Storage Area and Blast Wall (Facility No. 1684M), the Propellant Transfer Unit Enclosure (Facility No. 8610), and the Hazardous Storage Building (Facility No. 8602) remain in place in a good to a deteriorated condition.

Noting the significance of Launch Complex 14, three markers to the Mercury Program have been erected at or near the complex. These include: a Historic Site Kiosk (Facility No. 10901), a Mercury Memorial Monument (Facility No. 8600), and a Mercury Memorial (Facility No. 13514). The Mercury Monument is located on ICBM Road at the entrance to Launch Complex 14. This 13'-0" high stainless-steel astronomical symbol for the Planet Mercury was erected at the close of Project Mercury in 1964 to honor the astronauts who participated in the program. Situated at the south end of the Launch Ramp, the Mercury Memorial Monument is a monument to John Glenn, the first American to orbit the Earth in 1962 (Figure 6). The Historic Site Kiosk was erected in 1987 immediately east of the Blockhouse.[51]

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[50] Harry Butowsky, *National Register of Historic Places Nomination Form/National Historic Landmark Federal Agency Nomination: Cape Canaveral Air Force Station* (Washington, D.C.: National Park Service, 1983), 7:11; Master Planning, *CCAFS Basic Information Guide;* Real Property Cards, Cape Canaveral Air Force Station; Eastern Test Range Launch Complexes, 1991; Cleary, "45th Space Wing."

[51] Master Planning, *CCAFS Basic Information Guide*; Butowsky, *National Register Nomination*, 7:11.

ARCHITECTURAL DESCRIPTION OF LAUNCH COMPLEX 14

The U.S. Army Corps of Engineers initiated the construction process for Launch Complex 14 in March 1956. The complex reached "beneficial occupancy" status in January 1957 which was followed by the first launch of an Atlas missile in June. The Corps officially approved the plans and completed construction in August 1957.[52]

Initially designed to support the Atlas missile program, Launch Complex 14 was modified in 1959 and 1960 to support Project Mercury's orbital flights which were powered by an Atlas missile topped by the Mercury capsule. At the close of Project Mercury, the complex was again modified in 1963 and 1964 to launch the Atlas-Agena. Thirty-two launches, utilizing the Atlas A, Atlas B, Atlas D, Atlas-Able, Atlas-Agena A, Mercury-Atlas, and Atlas-Agena D configurations, occurred at Launch Complex 14, including the four manned Mercury missions.[53]

Launch Complex 14 consisted of a concrete Launch Stand and Ramp (Facility No.1684B) and associated structures serviced by one Blockhouse (Facility No.10905) and a Ready Building (no longer extant). Although simply noted as Launch Pad 14 in the 1958 *Basic Information Guide*, a Nose Cone Test Tower and Transponder Tower were noted along the entrance road, but were not included in the 1960 edition. This corresponds to the testing period of the Atlas B missile, the second Atlas prototype, which was designed to test nose cone separation among other systems. The first of nine Atlas B launches occurred on July 19, 1958, and the final launch completed the testing of this prototype on February 4, 1959.[54]

The following ancillary structures were noted in the 1960 *Basic Information Guide*: Sentry House, Water Demineralization Station (now the Compressor Building; Facility No.10915), Water Storage Tank, JP-4 Area and Blast Wall (Facility No. 1684H), LOX Storage Area and Blast Wall (Facility No. 1684M), Subcable Hut and Vault (now the Communications Cable

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[52] Real Property Cards, Cape Canaveral Air Force Station, 45th Space Wing Office of History, Patrick AFB; "Eastern Test Range Launch Complexes, Cape Canaveral AFS," 45th Space Wing Office of History, Patrick AFB, 16 April 1991; Mark Cleary, *Eastern Range Launches*, (45th Space Wing Office of History, Patrick AFB, 11 December 2002); Mark Cleary, "45th Space Wing: Its Heritage, History & Honors 1950-2001, Launch Facilities & Programs: Complexes 11, 12, 13, and 14" (45th Space Wing Office of History, Patrick AFB, 2001).

[53] Clifford J. Lethbridge, "Cape Canaveral Rocket and Missile Box Scores," Spaceline.org, Spaceline, Inc., 2001; Cleary, *Eastern Range Launches*; Cleary, "45th Space Wing."

[54] Clifford J. Lethbridge, "Atlas B Fact Sheet," Spaceline.org, Spaceline, Inc., 1998; Lethbridge, "Cape Canaveral Rocket and Missile Box Scores"; Pan American World Airways, Inc., *Basic Information Guide, 1958;* Pan American World Airways, Inc., *Basic Information Guide,* 1960.

Building; Facility No.10907), Flume and Skimming Basin (Facility No. 1684P), Petroleum, Oil and Lubricants (POL) Building (now the Hazardous Storage Building; Facility No.8602), two Fuel Oil Storage Tanks (one 500 gallon capacity and one 1,000 gallon capacity; no longer extant), and Septic Tanks to serve the Blockhouse, Launch Stand, and Ready Building (two extant, Facility No. 10912 and No. 10906). The Propellant Transfer Unit (now the Propellant Conditioning Facility; Facility No. 8610), the Hazardous Storage Shelter (no longer extant), the Mercury Memorial Monument (Facility No. 8600), the Mercury Memorial (Facility No. 13514), and the Historic Site Kiosk (Facility No. 10901) were subsequently constructed at the complex.[55]

The Launch Stand served as the hub of the complex, around which the remaining facilities were located. The Launch Stand area included the Launch Stand and Ramp, Flume and Skimming Basin, POL Building, Propellant Transfer Unit, Launch Pad Building, Mobile Service Structure, Umbilical Mast, and other major firing accessories. Other elements of the complex were separated from the launching area by distances dictated by propellant explosive hazards. Access to facility interiors (with the exception of the Blockhouse and the Propellant Transfer Unit Building) was not possible due to safety concerns.

Launch Stand and Ramp Area

Launch Stand and Ramp (Facility No. 1684B)

Constructed in 1957, the Launch Stand and Ramp (Facility No. 1684B) was approximately 432' long and could be visually divided into twelve bays (Figure 7). Constructed at a cost of approximately $777,074, the Ramp consisted of the southernmost eleven bays, while the Launch Stand was the northernmost bay. The Ramp was approximately 24' wide and gradually increased to a height of 22' over the northern six bays. The Launch Stand was wider than the Ramp at approximately 60' wide x 78' long, and supported the Umbilical Mast. The Launch Stand had a hold-down capability provided by two steel arms which attached to the base of the launch vehicle. These arms released through air pressure when sufficient thrust built during a launch. Utilized to cool the launch stand, water deluge and spray systems were mounted on the launch stand and released approximately 30,000 gallons of water per minute during engine operation. The southernmost bay of the Ramp was approximately 170' long and was constructed on earthen fill paved with concrete slabs. The remaining portion of the Ramp and Launch Stand was supported by a steel frame topped by a concrete slab with a balustrade along the edges constructed of 1-½" standard pipe rail. Utilizing canvas screen and corrugated asbestos cement

[55] Pan American World Airways, Inc., *Basic Information Guide, 1958*; Pan American World Airways, Inc., *Basic Information Guide, 1959*; Pan American World Airways, Inc., *Basic Information Guide, 1960*.

siding, the area under the Ramp was enclosed with two different levels to serve as space for Administration Control, Machine Shop, Storage, General Terminal and Transfer Room, Instrumentation Room, a Restroom, and Locker Room. These rooms held the hydraulic and pneumatic pressure units, electrical junctions and power supplies, equipment for pre-launch checkouts, landline instrumentation, air-conditioning equipment, and shops. In general, the rooms themselves had a concrete foundation and floor with walls and ceilings of gypsum board and exposed metal. The northern portion of the Launch Stand was razed in December 1976 due to excessive rust and deterioration.[56]

The concrete-block Launch Pad Building, which was approximately 57' x 20', extended under the Ramp approximately 6' south of the Launch Stand. The building held an Instrumentation Room and a General Terminal & Transfer Room. A small Compressor Room, approximately 20' x 10', was located on the east side of the Ramp approximately 155' north of the southeast corner. Tunnels and a cable tray containing circuitry extended from under the Launch Stand to the Blockhouse (Figure 8).[57]

Propellant Transfer Unit (PTU) Enclosure/Propellant Conditioning Facility (Facility No. 8610)

The Propellant Transfer Unit (PTU) Enclosure, now the Propellant Conditioning Facility (Facility No. 8610), was approximately 40' x 40' with 1,597 square feet of space and was located immediately east of the Launch Pad Building. Constructed around 1961 for the Mercury program, the building was originally considered part of the JP-4 Storage Area. The concrete-block building had a concrete foundation and a flat roof.[58]

Petroleum, Oil and Lubricants Building (POL) Building/Hazardous Storage Building (Facility No. 8602)

The Petroleum, Oil and Lubricants (POL) Building, now the Hazardous Storage Building (Facility No. 8602), was constructed in 1957 south of the JP-4 Storage Area and approximately

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[56] Pan American World Airways, Inc., Cover Sheet and Drawings 01-01684-005, 01-01684-040, and 01-01684-041; Master Planning, *CCAFS Basic Information Guide*; Butowsky, *National Register of Historic Places Nomination*, 7:10; United States Air Force, Property Cards 01-1684 and 1684B, Launch Complex 14 files.

[57] Pan American World Airways, Inc., Cover Sheet and Drawings 01-01684-005, 01-01684-040, and 01-01684-041; Master Planning, *CCAFS Basic Information Guide*; Butowsky, *National Register Nomination*, 7:10; United States Air Force, Property Cards 01-1684 and 1684B, Launch Complex 14 files.

[58] Pan American World Airways, Inc., Drawing 01-01684-005; Master Planning, *CCAFS Basic Information Guide;* Bramlitt, 98; United States Air Force, Property Cards 01-1684 and 8610, Launch Complex 14 files; Photographs 63-ma9-93 and 61-PL-61-70005, University of Central Florida, Florida Space Coast History Project, scanned copy provided courtesy of Al Hartmann.

80’ east of the Launch Stand and Ramp. This concrete-block building, with 120 square feet of space, rested on a concrete foundation and had a flat roof.[59]

Flume and Skimming Basin (Facility No. 1684P)

The Flume and Skimming Basin was a ditch lined with poured concrete which extended from under the Launch Stand north beyond the access road to a collection pond lined with poured concrete. This structure provided for the runoff and collection of water and propellant overflow (Figure 9).[60]

Umbilical Mast and Service Structure

The Umbilical Mast (also referred to as Umbilical Tower) and Service Structure were also part of the complex (Figure 10). The Umbilical Mast supported the missile, both of which rested on the Launch Stand. The Umbilical Mast provided various electrical cables, pneumatic lines, checkout consoles, cryogenic replenishing lines, liquid nitrogen cooling tanks, mechanical refrigeration units, air conditioning ducts, valve complexes, and other systems necessary to service the booster and upper stages. Constructed of ten levels of steel framing, the Umbilical Mast was an open truss steel structure which rose 84’-6” above the Launch Stand.[61]

Similarly, the Service Structure consisted of 14 movable decks of steel framework trapezoidal in shape which rose 154’-8”. The Service Structure, which provided work platforms for the assembly, checkout, and servicing of the launch vehicle, was an inverted U-shaped, rigid box truss frame design. The Service Structure was mounted on rails which moved it to a rail-mounted transfer table. The table carried the Service Structure from the Launch Stand area east to the Service Structure Parking Area, approximately 300’ east of the Launch Stand. Representing a shift from use exclusively for the Atlas ICBM to use as a site for launching a Space Launch Vehicle, the Service Structure was modified in 1959 for Project Mercury. The Service Structure

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[59] Pan American World Airways, Inc., Drawing 01-01684-005; Pan American World Airways, Inc., *Basic Information Guide*, 1960; Master Planning, *CCAFS Basic Information Guide;* United States Air Force, Property Cards 01-1684 and 8602, Launch Complex 14 files.

[60] Pan American World Airways, Inc., Cover Sheet and Drawings 01-01684-005, 01-01684-040, and 01-01684-041; Master Planning, *CCAFS Basic Information Guide*.

[61] Pan American World Airways, Inc., Drawings 01-01684-005, 01-01684-040, and 01-01684-041; Maurice H. Connell & Associates, Inc., Drawing 01-01684-197; Master Planning, *CCAFS Basic Information Guide*.

and the Umbilical Mast were razed in December 1976 as a result of excessive rust and deterioration.[62]

Fuel Storage Areas

Liquid Oxygen Storage Area and Blast Wall (Facility No. 1684M)

The Liquid Oxygen (LOX) and Gaseous Nitrogen (GN_2) storage area was situated approximately 500' east of the Ready Building, between the Ready Building and the Launch Stand and Ramp. This fuel storage area, which consisted of a LOX tank, a LOX Sub-cooler, and storage for GN_2 bottles/tanks, was situated on a concrete slab foundation. Nitrogen was utilized to purge fuel and LOX lines, engine and instrument compartments, and to operate certain pneumatic components. Initially supplied by trucks, three Nitrogen tanks were subsequently installed at the facility. The 28,000-gallon capacity LOX tank was constructed of steel with an aluminum inner liner. The LOX flowed through stainless steel lines to the vehicle at a rate of 1,600 gallons per minute transferred by two pumps with flow control maintained by 150 pounds per square inch air pressure. A reinforced concrete blast wall, approximately 110' long x 30' wide with earthen fill on the east side, bordered this fuel storage area on the east to separate the fuel from the Launch Stand and Ramp.[63] Only one tank remains at Facility No.1684M, but it is not in its original position.

Jet Propellant-4 (JP-4) Storage Area (Facility No. 1684H)

Approximately 100' east of the Launch Stand and Ramp, the Jet Propellant-4 (JP-4) storage area consisted of a 16,000 gallon storage tank which was separated from the launch area on the north by a reinforced concrete blast wall approximately 50' long (Figure 11). The tank has been removed from the site, probably soon after the facility was deactivated.

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[62] Pan American World Airways, Inc., Drawings 01-01684-005, 01-01684-116, 01-01684-117, and 01-01684-118; Butowsky, *National Register Nomination*, 7:10.

[63] Pan American World Airways, Inc., Drawings 01-01684-005; Master Planning, *CCAFS Basic Information Guide*; Butowsky, *National Register Nomination*, 7:10; Al, Hartmann, volunteer, Air Force Space and Missile Museum, interview by author, 30 April, 28 May, and 16 June, 2003, CCAFS, notes from interview and e-mail, Archaeological Consultants, Inc., Sarasota.

Blockhouse and Ready Building

Blockhouse (Facility No. 10905)
Located approximately 750' west of the Launch Stand and Ramp, the domed Blockhouse (Facility No. 10905) operated as the launch control center housing the communications, instrumentation, and control consoles. For the construction of the Blockhouse in 1957, a large area was excavated and partially filled with sand onto which the reinforced concrete foundation was poured (Figure 12). The 12-sided, dome-shaped portion of the building consisted of three different layers. The inner dome was constructed of reinforced concrete, poured 10'-6" thick at the base surrounded by 40' of sand. A retaining wall around the base held the sand in place. At the apex of the dome, the inside dome was reinforced concrete poured 5'-6" thick, covered by approximately 7' of sand. The earthen fill was covered with a four inch thick layer of gunite-concrete. A special blast proof door further insulated the structure to withstand the blast pressure should a missile explode on the pad or near the launch site. With 24,925 square feet of space, the building was constructed at a cost of approximately $821,989.[64]

These insulating layers provided the Blockhouse with an interior floor-space diameter of approximately 60' (Figure 13). Although the Control Room occupied most of the space, the Blockhouse also had a Mechanical Equipment Room, a Restroom, and a small glass enclosed Observation Room. The floor had inset cabling trenches covered with vinyl flooring, while the base of the walls was covered with rubber and the top by gypsum board and acoustic tile. Two oval-shaped air intake and exhaust openings in the northeast wall of the Blockhouse provided fresh air to the mechanical equipment room which was separated from the control room by an acoustic wall. Wall mounted lights illuminated the room. An opening in the floor led to the electrical pit and tunnels containing electrical wiring which connected the Blockhouse to the Launch Stand. An escape hatch led from the Control Room to the lower of two connected observation platforms on the east side of the Blockhouse roof. Four periscopes in the control room provided views of the launch. These periscopes and most of the interior finishes remain intact, although the floor is now covered with carpet.[65]

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[64] Bramlitt, *History of Canaveral District 1950-1971*, 17; Master Planning, *CCAFS Basic Information Guide*; Pan American World Airways, Inc., Drawings 01-01684-005, 01-01684-031, 01-01684-032, and 01-01684-033; United States Air Force, Property Cards 01-1684, 10905, and 1684A, Launch Complex 14 files.

[65] Bramlitt, 17; Pan American World Airways, Inc., Drawings 01-01684-005, 01-01684-031, 01-01684-032, and 01-01684-033; Master Planning, *CCAFS Basic Information Guide;* United States Air Force, Property Cards 01-1684, 10905, and 1684A, Launch Complex 14 files.

The dome of the Blockhouse extended to cover a breezeway on the west side of the building which separated the domed area from a one-story rectangular extension of the Blockhouse called the Equipment Shelter. This extension was constructed of concrete-block and wood frame clad with corrugated asbestos cement and topped by a flat roof. The Equipment Shelter included a power room, office, equipment shelter, transformer and switch gear room, and restroom.[66]

Ready Building/Contractor Support Building

Situated south of the Blockhouse and the Sentry House, the Ready Building (later the Contractor Support Building), had 4,320 square feet of space. Set on a concrete foundation, the Ready Building was constructed in 1957 of wood frame, clad with corrugated asbestos cement, and topped by a flat roof. The floor plan for the building incorporated a Briefing Room, Workshop, Test Conductor’s office, Office, Conference Room, Heater Room, Storage, and a Men’s and Women’s Restroom. The public rooms had asphalt tile floors, walls clad with wood and gypsum board, and an acoustic board ceiling. Windows were originally four- and eight-light pivot windows, but were replaced by one-over-one single-hung sash windows.[67] The Ready Building was razed between 2010 and 2014.

Ground Support Equipment

Electrical, water, and fire suppression systems supported the activities at Launch Complex 14. In addition to the primary support structures, cabling and pipeline connected the structures to form a cohesive complex. Cabling and pipeline included 9,592' of water mains, 462' of hydro-pneumatic lines, 1,820' of lines for the nitrogen system, 954' of lines for the LOX system, 357' of lines for the helium system, 418' of pipeline for the liquid fuel system, and 10,341' of cable ducts, as well as the cable tray system itself.[68]

Water Demineralization Station/Compressor Building (Facility No. 10915) and Water Storage Tank

According to the 1960 *Basic Information Guide*, the Water Demineralization Station and Water Storage Tank were located at the entrance to the complex, west of the Blockhouse and Ready

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[66] Pan American World Airways, Inc., Drawings 01-01684-005, 01-01684-031, 01-01684-032, and 01-01684-033; United States Air Force, Property Cards 01-1684, 10905, and 1684A, Launch Complex 14 files.

[67] Pan American World Airways, Inc., Drawings 01-01684-036, 01-01684-037; Pan American World Airways, Inc., *Basic Information Guide,* 1960; Master Planning, *CCAFS Basic Information Guide;* United States Air Force, Property Cards 01-1684 and 10911, Launch Complex 14 files.

[68] United States Air Force, Property Card 01-1684, Launch Complex 14 files.

Building. The Water Demineralization Station, constructed in 1957, is now the Compressor Building which is not presently in use (Facility No. 10915). The concrete-block Compressor Building has 386 square feet of space, a flat roof, and a concrete slab foundation. The steel Water Storage Tank was a 500 gallon hydro-pneumatic tank installed in 1957 to support the demineralized water system at the complex. It was removed and salvaged in 1983.[69]

Septic Tanks (Facility No. 10912 and No. 10906) and Fuel Oil Storage Tanks

Two Septic Tanks and Fuel Oil Storage Tanks were identified in the 1960 *Basic Information Guide* near the Blockhouse and the Ready Room. Both Septic Tanks (Facility No. 10912 and No. 10906) remain, but the Fuel Oil Storage Tanks (later the Diesel Fuel Tanks; former Facility No. 10913) were removed between 1995 and 2003.[70]

Subcable Hut and Vault/Communications Cable Building (Facility No. 10907)

The Subcable Hut and Vault (now the Communications Cable Building; Facility No. 10907) is located immediately west of the Blockhouse. This small building, built in 1957 with only 315 square feet of space, was constructed of concrete-block set on a concrete slab foundation with a flat roof.[71]

Hazard Storage Shelter (Facility No. 10914)

A metal Hazard Storage Shelter (Facility No. 10914) with 550 square feet of space was a metal enclosure with a metal roof set on a concrete slab foundation. A 1,000 gallon tank owned by Glover Oil Company was contained in the enclosure. Located west of the Ready Room near the entrance to the complex, it was constructed in 1992.[72] The facility was razed between 2005 and 2007.

Sentry House (Facility No. 1684)

A small, wood frame Sentry House is located between the Blockhouse and the Ready Building. The original Sentry House was surfaced with aluminum and asbestos cement siding and topped

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[69] United States Air Force, Property Cards 01-1684 and 10915, Launch Complex 14 files; Pan American World Airways, Inc., *Basic Information Guide,* 1960.

[70] Master Planning, *CCAFS Basic Information Guide;* Pan American World Airways, Inc., *Basic Information Guide*, 1960; Pan American World Airways, Inc., *Basic Information Guide,* 1981; United States Air Force, Property Cards 01-1684, 10906, and 10912, Launch Complex 14 files.

[71] Pan American World Airways, Inc., Drawings 01-01684-005, 01-01684-031, 01-01684-032, and 01-01684-033; Master Planning, *CCAFS Basic Information Guide;* United States Air Force, Property Cards 01-1684 and 10907, Launch Complex 14 files.

[72] United States Air Force, Property Card 10914, Launch Complex 14 files.

by a flat roof. It was removed around 1970. The existing Sentry House was moved to its current location in approximately 1998.[73] It is a wood frame rectangular structure with Dutch door on north and south sides. The upper section of the facility is composed single-pane fixed and jalousie windows. The facility is topped with a flat builtup roof, with an aluminum gravel coping. A section of security fence has been set up directly to the west of the Sentry House and directly west of the fencing is a commemorative installation of four parking spaces with concrete stops labeled with the names "JOHN H. GLENN JR. LT COL.," "M. SCOTT CARPENTER LCDR," "WALTER M. SCHIRRA JR. LCDR," "L. GORDON COOPER MAJ.," and "CX-14 LAUNCH DIRECTOR." A sign on the fencing provides "Welcome to Complex 14, Launch Site of Free World's First ICBM; Free World's First Man In Orbit."

Modifications and Deactivation

Designed to support the Atlas missile program, Complex 14 received only minor modifications in 1959 and 1960 when the complex was assigned to serve Project Mercury (Figure 14). Modifications included the construction of an emergency egress tower, changes to the configuration of the top of the gantry to accommodate the escape rocket tower, construction of the Propellant Transfer Unit (PTU) (Facility No. 8610), and the installation of a "white room" in the upper two decks of the Service Structure (Figure 15). The "white room," which housed the spacecraft, featured a controlled environment in order to minimize the effects of humidity and dust on the delicate components of the spacecraft. The emergency egress tower provided the astronaut with a means to evacuate the spacecraft by way of a platform which extended to the door of the spacecraft. An external egress crew could utilize the tower if the astronaut was incapacitated.[74]

At the close of Project Mercury, Launch Complex 14 was further modified between 1963 and 1965 to launch the Atlas-Agena, with alteration costs totaling over $1.5 million. At this time, the emergency egress tower was dismantled, and a new 101' Umbilical Tower was constructed to serve the specific needs of the Agena. Other modifications included alterations to the "white room" in the Service Structure to house the Agena fuel and pressure servicing units for pre-launch checks of the spacecraft, installation of a new LOX storage tank, and alterations to the

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[73] Pan American World Airways, Inc., Drawings 01-01684-005, 01-01684-031, 01-01684-032, and 01-01684-033; Master Planning, *CCAFS Basic Information Guide;* United States Air Force, Property Cards 01-1684 and T1684C, Launch Complex 14 files; United States Air Force, "Real Property Voucher," Voucher No. 70-1343, Space Gateway Support Company, GIS Real Property Office, John F. Kennedy Space Center.

[74] Butowsky, *National Register Nomination*, 7:9; Mark C. Cleary, *The 6555th Missile and Space Launches Through 1970,* (45th Space Wing Office of History, Patrick AFB, 1991), 126.

Launch Stand (Facility No. 1684B), Blockhouse (Facility No. 10905), and Ready Room. New facilities at the Launch Stand and Ramp included additional cable trenches for the Agena, a Lockheed and McDonnell equipment room, and a mechanical shop.[75]

Launch Complex 14 was deactivated in 1967 and abandoned in place October 31, 1973. After October 1967, property records reveal continuing modifications to the complex with the removal of consoles, machinery, cabling, pipeline, and power, safety, lighting, and cooling systems. Most of these items were reused in other complexes. The Sentry House was removed around 1970. Following the abandonment of the complex in 1973, the facilities at the complex were no longer maintained. Between 1974 and 1979, the LOX tank was transferred to NASA and was later removed. The LOX piping and the Cable Tray System were removed in 1976 due to excessive rust and deterioration. During 2007–2008, a restoration project repaired the ramp surface, replaced handrails, removed light fixtures, and added temporary support structures to the Launch Ramp structural system. Most of the structure of the Launch Ramp, as well as the accompanying Launch Pad Building, remain intact, but are in poor condition. With the exception of a few concrete-block walls, little evidence remains of the rooms under the Launch Stand and Ramp and all of the electrical equipment has been removed. The Water Storage Tank was removed in 1983. The Hazard Storage Shelter (Facility No. 10914) was added to the complex in 1992, but was razed between 2005 and 2007. The PTU facility was refurbished in 1985/1986, including replacement of doors and a new roll-up door on the south facade. The Blockhouse was restored and converted to meeting space in 1998. During the same period, the existing Sentry House, similar to the original, was moved to its current location. Although the machinery associated with the program was removed from the Blockhouse, the original periscopes and many of the original finishes remain intact. In 2000, the Blockhouse concrete roof and perimeter wall was repaired, and this work was continued in 2002–2003. A restoration program for the periscopes was undertaken in the late 2000s. The Blockhouse, Flume and Skimming Basin, Water Demineralization Station, and Subcable Hut and Vault remain in fair-to-good condition. Portions of the Launch Stand and Ramp, JP-4 Area and Blast Wall, the LOX Storage Area and Blast Wall, the PTU Enclosure, and the POL Building remain in place but are in a very deteriorated condition.[76]

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[75] ibid.; Pan American World Airways, Inc., Drawing 01-01684-005; Master Planning, *CCAFS Basic Information Guide;* Bramlitt, 98.

[76] United States Air Force, Property Cards 01-1684, 10914, and 10915, Launch Complex 14 files; United States Air Force, Voucher Nos. 70-1343, 79-1081, and 75-1060; Photograph 76-PL-76-37401.4, University of Central Florida, Florida Space Coast History Project, scanned copy provided courtesy of Al Hartmann; Butowsky, *National Register Nomination*, 7:11; Master Planning, *CCAFS Basic Information Guide;* Real Property Cards, Cape Canaveral Air Force Station.

Launch Complex 14 was listed as part of the Cape Canaveral Air Force Station National Historic Landmark District on April 16, 1984. Noting the significance of Launch Complex 14, three markers to the Mercury Program have been erected at or near the complex. These include: a Historic Site Kiosk (Facility No. 10901), a Mercury Memorial Monument (Facility No. 8600), and Mercury Monument (Facility No. 13514). The Mercury Monument is located on ICBM Road at the entrance to Launch Complex 14. This 13'-0" high stainless steel astronomical symbol for the Planet Mercury surrounding the number seven was erected at the close of Project Mercury in 1964 to honor the astronauts who participated in the program. Situated at the south end of the Launch Ramp, the Mercury Memorial Monument is a monument to John Glenn, the first American to orbit the Earth in 1962. The marble monument was installed in 1980. The Historic Site Kiosk is located immediately east of the Blockhouse and was installed in 1987.[77]

[77] Master Planning, *CCAFS Basic Information Guide*; Butowsky, *National Register Nomination*, 7:11; United States Air Force, Property Cards 13514 and 10901, Launch Complex 14 files.

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Photographs. 45th Space Wing History Office, Patrick Air Force Base. Scanned copy provided courtesy of Al Hartmann.

Photographs. University of Central Florida, Florida Space Coast History Project. Scanned copy provided courtesy of Al Hartmann.

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HISTORIC DRAWINGS

As of 2016, the technical drawings used for research in this study have not been cleared for release to the public domain. It is, therefore, not possible to reproduce in this document the drawings used to gather information about the design, construction, and use of facilities at Launch Complex 14, CCAFS.

APPENDIX: FIGURES FROM DATA PAGES

Figure 1. Location of Launch Complex 14, CCAFS. Air Force Space and Missile Museum.

Figure 2. Preparation for launch of an Atlas-Agena A with MIDAS payload, May 24, 1960. Photograph ETR LC-14, Atlas 45D, located at San Diego Aerospace Museum.

Figure 3. Launch of the first successful orbital flight of Mercury capsule, Mercury 4, September 13, 1961. Photograph ETR LC-14, Atlas 88D, located at San Diego Aerospace Museum.

Figure 4. Launch of Gemini Target Vehicle 9A utilizing Atlas-Agena D configuration, June 1, 1966. Photograph ETR LC-14, Atlas 5304, located at San Diego Aerospace Museum.

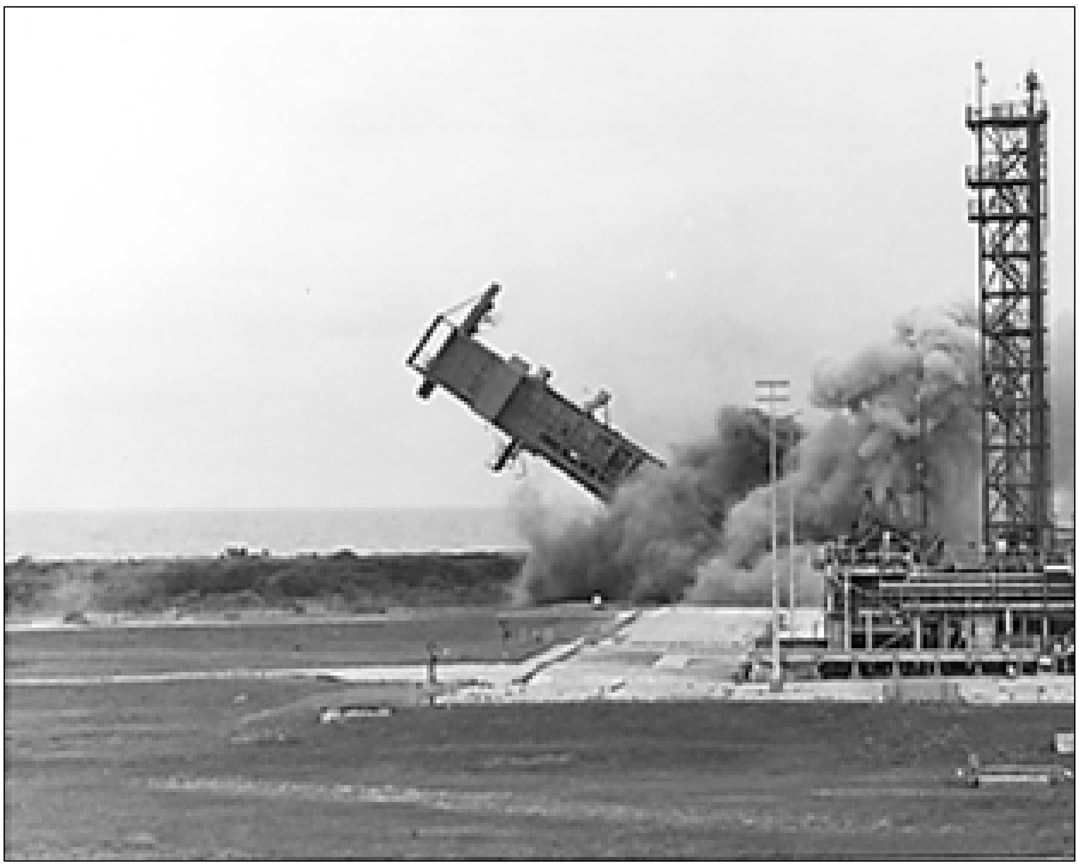

Figure 5. Demolition of Service Structure, December 1, 1976. Photograph 76-PL-76-37401.4, U.S. Air Force, located at University of Central Florida, Florida Space Coast History Project.

Figure 6. Senator John Glenn at the Dedication of the Mercury Memorial Monument, February 20, 1980. Photograph 116-KSC-80PC-103, NASA, located at University of Central Florida, Florida Space Coast History Project.

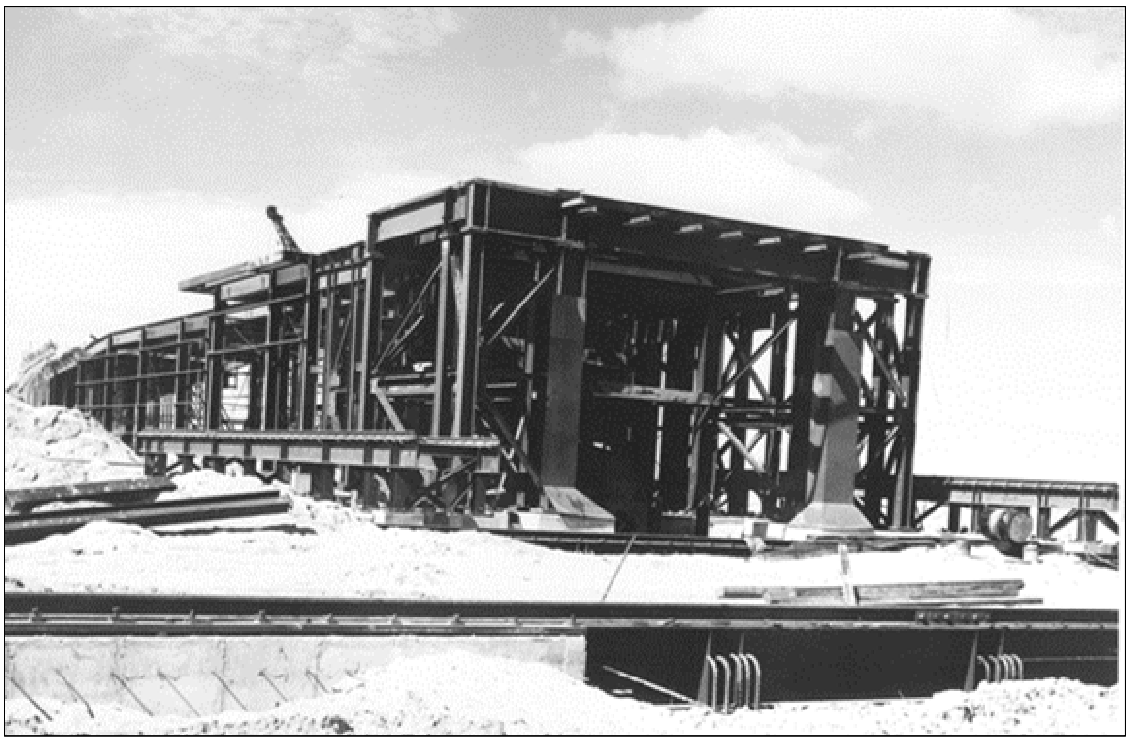

Figure 7. Launch Stand and Ramp and Rails for Mobile Service Structure under construction, ca. 1956. Photograph 56-13045, located at University of Central Florida, Florida Space Coast History Project.

Figure 8. Mercury-Atlas 9 in preparation for launch, May 15, 1963. Note Launch Stand and Ramp, Umbilical Mast behind Ramp, Service Structure to left of Ramp, and LOX and GN2 Storage Area in foreground. Photograph located at San Diego Aerospace Museum.

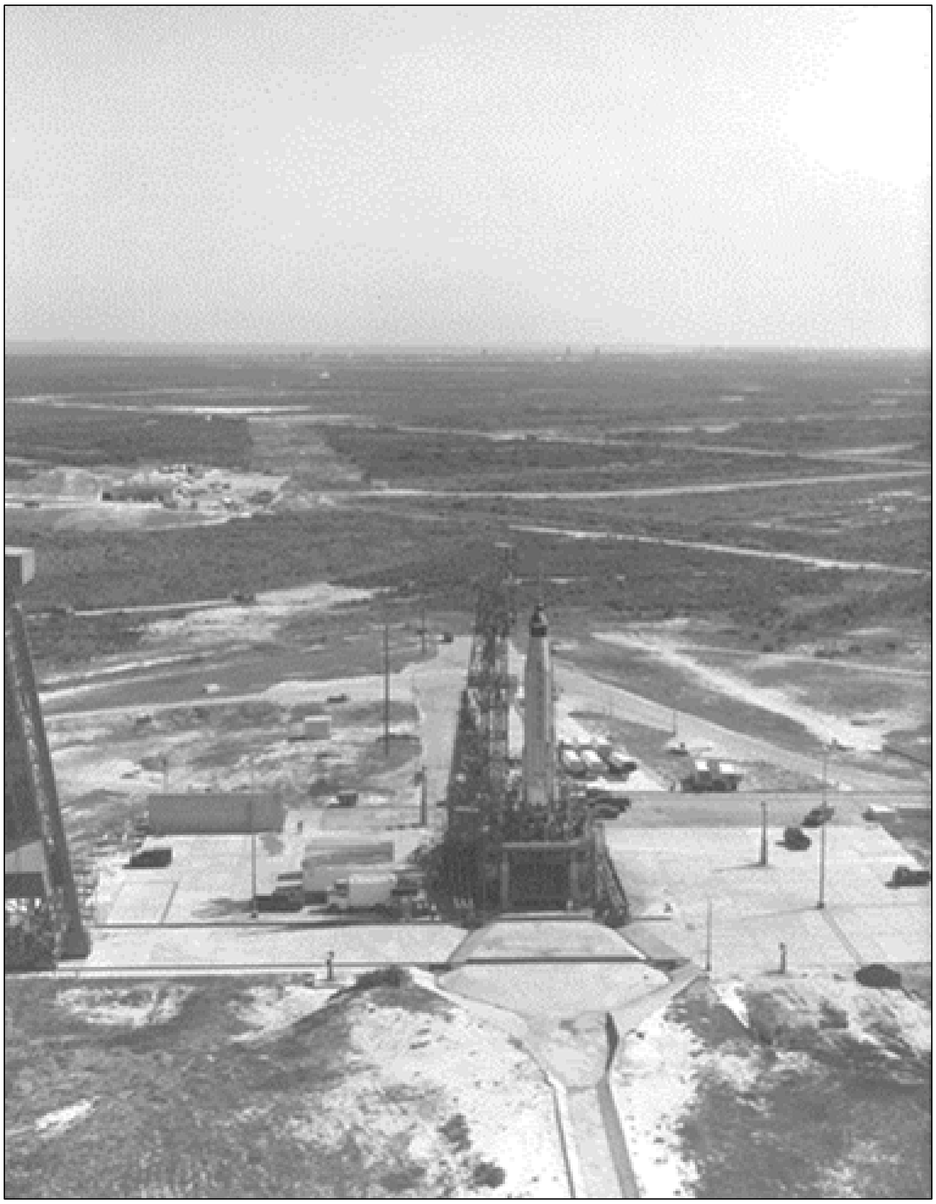

Figure 9. Preparation for Mercury-Atlas 9, May 10, 1963. Mercury-Atlas on Launch Stand with Umbilical Mast. Flume and Skimming Basin in front of Launch Stand. Service Structure at extreme left of photograph. PTU Enclosure and JP-4 Storage Area to left of Launch Stand. Photograph 63-ma9-93, NASA, located at University of Central Florida, Florida Space Coast History Project.

Figure 10. Preparation for launch of an Atlas-Able, November 26, 1959. Mobile Service Structure left of Launch Stand and Umbilical Mast on the right. Photograph ETR LC-14, Atlas 20D, located at San Diego Aerospace Museum.

Figure 11. Preparation for Atlas A Launch, December 17, 1957. Note JP-4 Storage Area in foreground. Photograph located at San Diego Aerospace Museum.

Figure 12. Launch Complex 14 Blockhouse under construction, 1956. Photograph 56-12416, RCA, U.S. Air Force, located at 45th Space Wing History Office, Patrick Air Force Base.

Figure 13. Interior of Launch Complex 14 Blockhouse under construction, 1956. Photograph 56-15131, RCA, U.S. Air Force, located at 45th Space Wing History Office, Patrick Air Force Base.

Figure 14. Preparation for launch of an Atlas B, November 29, 1958. Launch Stand, Umbilical Tower on right, and Mobile Service Structure on left prior to 1960 modifications for project Mercury. Photograph ETR LC-14, Atlas 12B, located at San Diego Aerospace Museum.

Figure 15. Preparation for launch of an Atlas D, May 19, 1959. Test Stand and Umbilical Mast in center, and Mobile Service Structure in parking area on left, following modifications for project Mercury. Photograph ETR LC-14, Atlas 7D, located at San Diego Aerospace Museum.

CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 14
East side of ICBM Road
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HAER No. FL-8-7

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HISTORIC AMERICAN ENGINEERING RECORD
Southeast Regional Office
National Park Service
U. S. Department of the Interior
100 Alabama Street, S.W.
Atlanta, GA 30303

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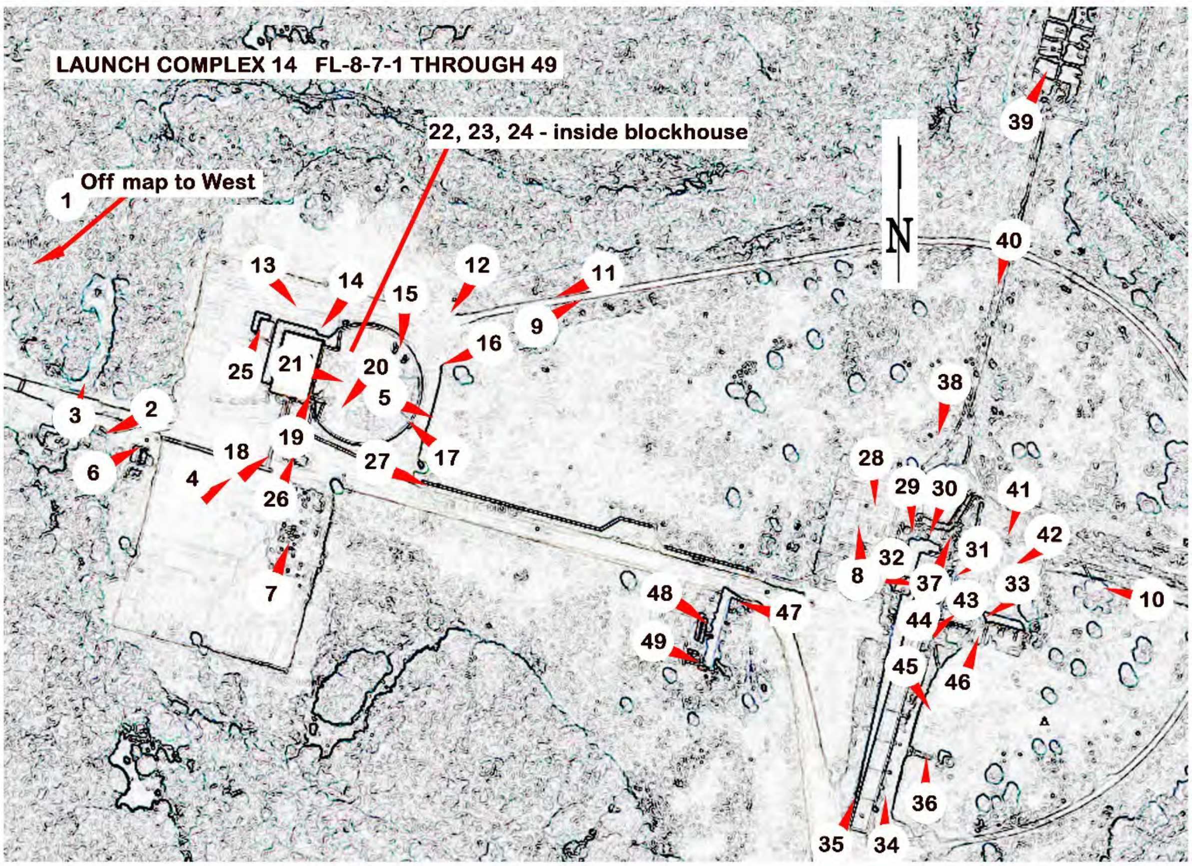
Photographer: Martin Stupich, 2014
See photo key on page 3 of Index to Photographs

FL-8-7-1	MERCURY MEMORIAL, WEST ENTRANCE TO LC-14 SITE; VIEW TO EAST (on photo key as #1)
FL-8-7-2	PUMPING FACILITY AT WEST ENTRANCE, VIEW TO NORTH (on photo key as #3)
FL-8-7-3	GENERAL VIEW, BLOCKHOUSE AREA: (L-R) COMMUNICATIONS CABLE BUILDING/SUBCABLE HUT AND VAULT, BLOCKHOUSE, SENTRY STATION AND (DISTANT RIGHT) LAUNCH PAD, RAMP AND BLAST WALL; VIEW TO EAST (on photo key as #4)
FL-8-7-4	GENERAL VIEW OF OPEN SPACE BETWEEN BLOCK HOUSE AND LAUNCH STAND, VIEW TO EAST (on photo key as #5)
FL-8-7-5	REMNANTS OF HAZARD STORAGE BUILDINGS, VIEW TO NORTHEAST (on photo key as #6)
FL-8-7-6	TANK SUPPORT NEAR SITE OF FORMER CONTRACTOR SUPPORT BUILDING (on photo key as #7)
FL-8-7-7	GENERAL VIEW OF WEST SIDE OF PAD, SHOWING CONCRETE REMNANTS OF ANCILLARY STRUCTURES, VIEW TO NORTH (on photo key as #8)

FL-8-7-8	ONE OF SEVERAL CAST CONCRETE STRUCTURES, EACH WITH STEEL TOP-ACCESS TRAPDOOR; THIS AT NORTH LOOP ACCESS ROAD; VIEW TO NORTHEAST (METAL POST AND STAND AT TOP ARE NOT ORIGINAL TO ARTIFACT; FOREIGN TO SITE) (on photo key as #9)
FL-8-7-9	VIEW SHOWING SERVICE TOWER RAIL OVERTAKEN BY SOIL AND VEGETATION; VIEW TO WEST (on photo key as #10)



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East side of ICBM Road
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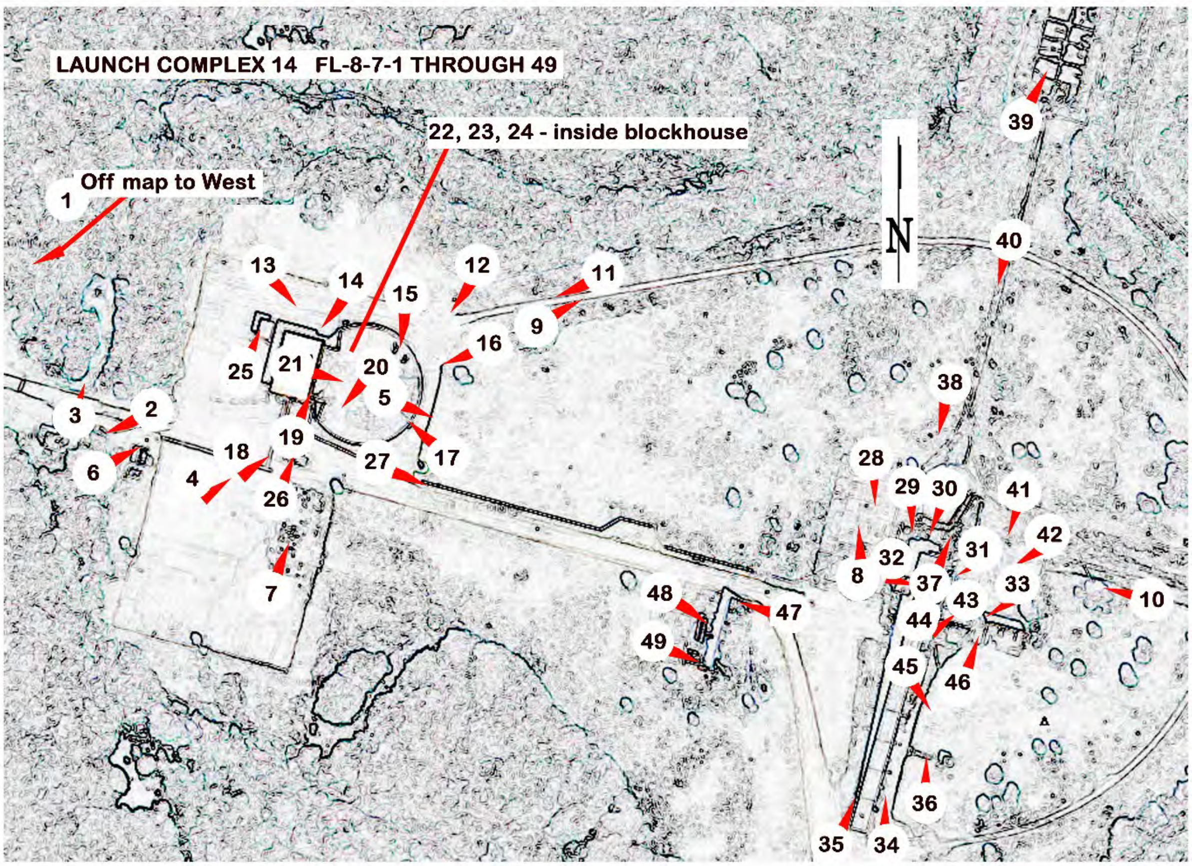
Photographer: Martin Stupich, 2014
See photo key on page 3 of Index to Photographs

FL-8-7-A-1	GENERAL VIEW OF BLOCKHOUSE VIEW EAST TO WEST (on photo key as #11)
FL-8-7-A-2	BLOCKHOUSE, GENERAL VIEW SOUTH TO NORTH (on photo key as #12)
FL-8-7-A-3	BLOCKHOUSE, GENERAL VIEW NORTHWEST TO SOUTHEAST (on photo key as #13)
FL-8-7-A-4	DETAIL, BLOCKHOUSE WEST END AND FACILITY NO. 10907 FAR RIGHT, VIEW TO SOUTHWEST (on photo key as #14)
FL-8-7-A-5	DETAIL, BLOCKHOUSE SHOWING TWO CORRUGATED AIR INTAKE AND EXHAUST OPENINGS (on photo key as #15)
FL-8-7-A-6	DETAIL, BLOCKHOUSE ROOF WITH CONCRETE STAIRS AND LUMBER OBSERVATION DECKS; NOTE FOUR PERISCOPES UPPER RIGHT (on photo key as #16)
FL-8-7-A-7	BLOCKHOUSE SHOWING ROOF FEATURES INCLUDING PERISCOPES, STAIRS AND OBSERVATION DECKS, VIEW EAST TO WEST (on photo key as #17)

FL-8-7-A-8	GENERAL VIEW OF BLOCKHOUSE AREA, ENTRY TUNNEL, BLOCKHOUSE DOME, COMMEMORATIVE ASTRONAUTS‘ PARKING SPACES AND (FAR RIGHT) SENTRY HOUSE, WITH HISTORIC SITE KIOSK; VIEW TO NORTHEAST (on photo key as #18)
FL-8-7-A-9	BLOCKHOUSE ENTRY TUNNEL AND GRAPHIC LAUNCH RECORD AS PLAQUE ABOVE PORTAL, VIEW TO NORTH (on photo key as #19)
FL-8-7-A-10	ROOF DETAIL, PERISCOPES WITH SENTRY HOUSE LOWER DISTANCE; VIEW TO SOUTHWEST (on photo key as #20)
FL-8-7-A-11	MAIN FORTIFIED DOOR WITH MASSIVE MECHANICAL PIN LOCKS LEADING TO BLOCKHOUSE ACCESS CORRIDOR AND CONTROL ROOM; VIEW TO EAST (on photo key as #21)
FL-8-7-A-12	MAIN CONTROL ROOM INTERIOR CONVERTED TO CONFERENCE ROOM, VIEW TO NORTH (on photo key as #22)
FL-8-7-A-13	CONTROL ROOM INTERIOR VIEW OF PERISCOPE AND EMERGENCY EGRESS DOOR IN KNEE WALL; VIEW TO NORTH (on photo key as #23)
FL-8-7-A-14	CONTROL ROOM INTERIOR, EMERGENCY EGRESS DOOR IN KNEE WALL SHOWING CONCRETE TUNNEL THROUGH BLOCKHOUSE BASE, LEADING TO ESCAPE HATCH; VIEW TO EAST (on photo key as #24)



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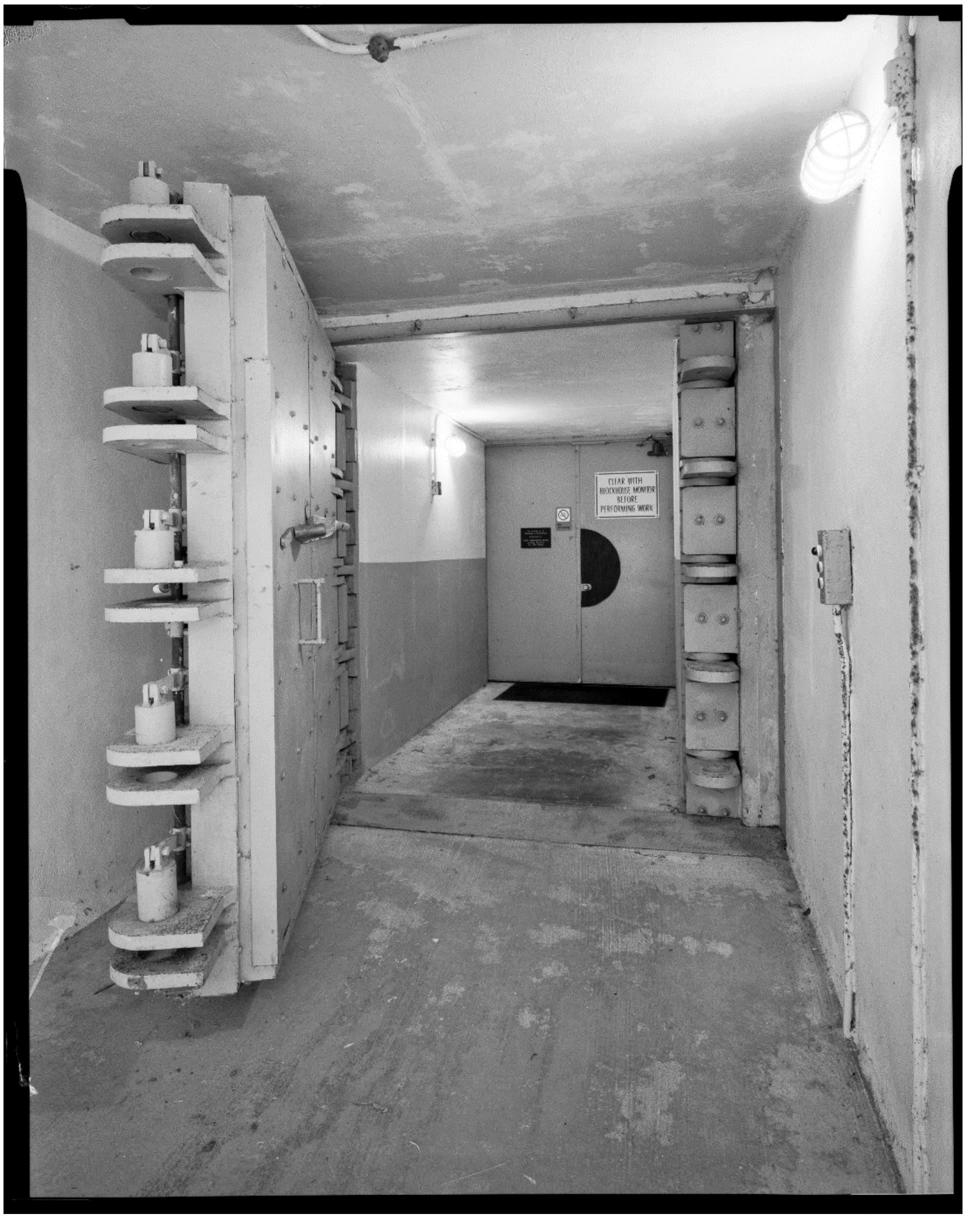

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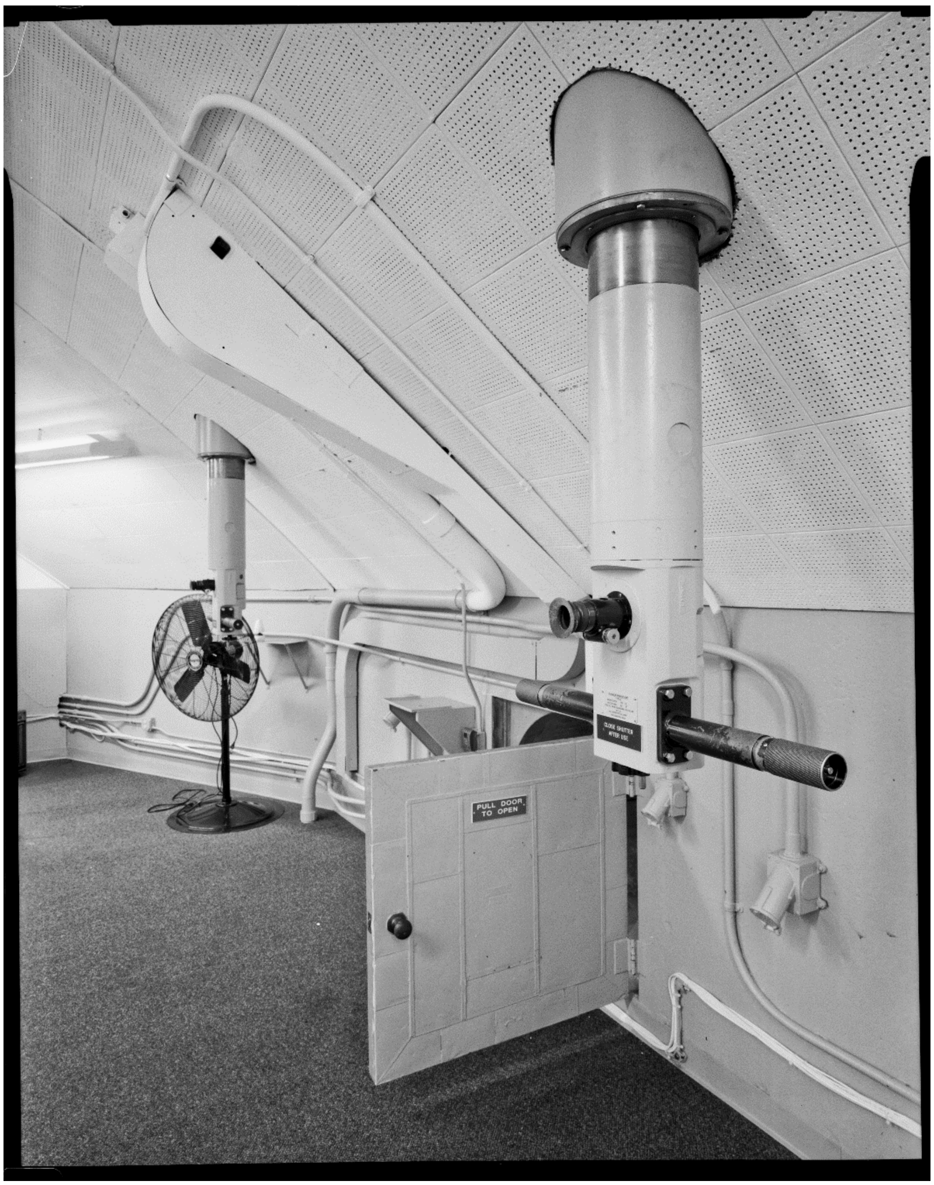

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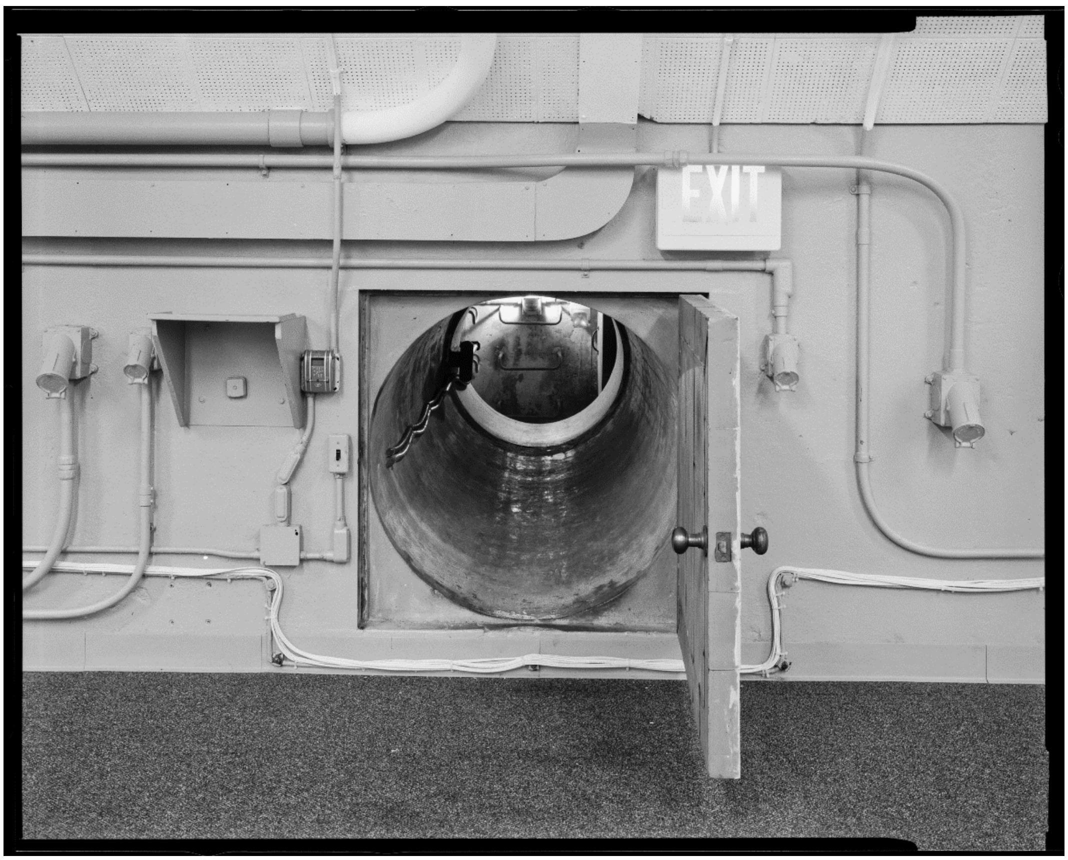

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(LAUNCH COMPLEX 14, COMMUNICATIONS CABLE BUILDING)
East side of ICBM Road
Cape Canaveral
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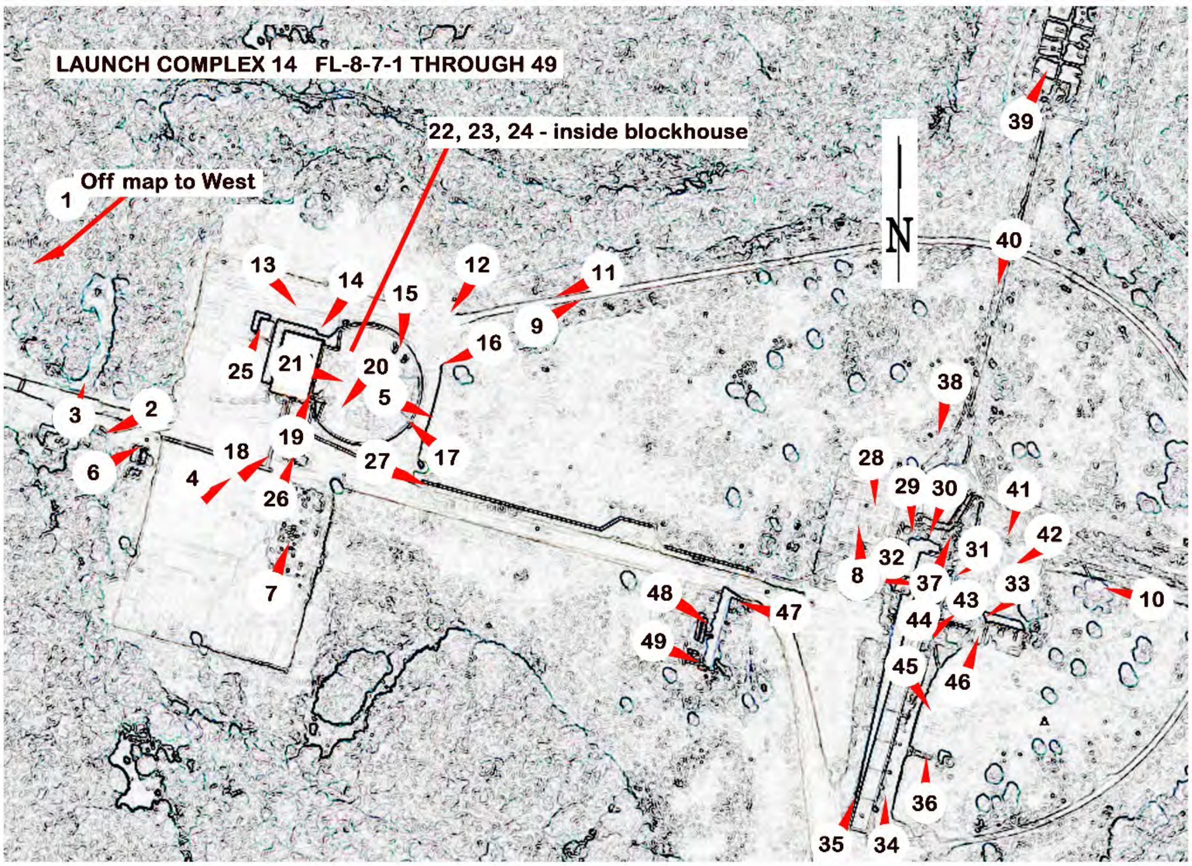
Photographer: Martin Stupich, 2014
See photo key on page 2 of Index to Photographs

FL-8-7-B-1	COMMUNICATIONS CABLE BUILDING, SUBCABLE HUT AND VAULT (on photo key as #25)



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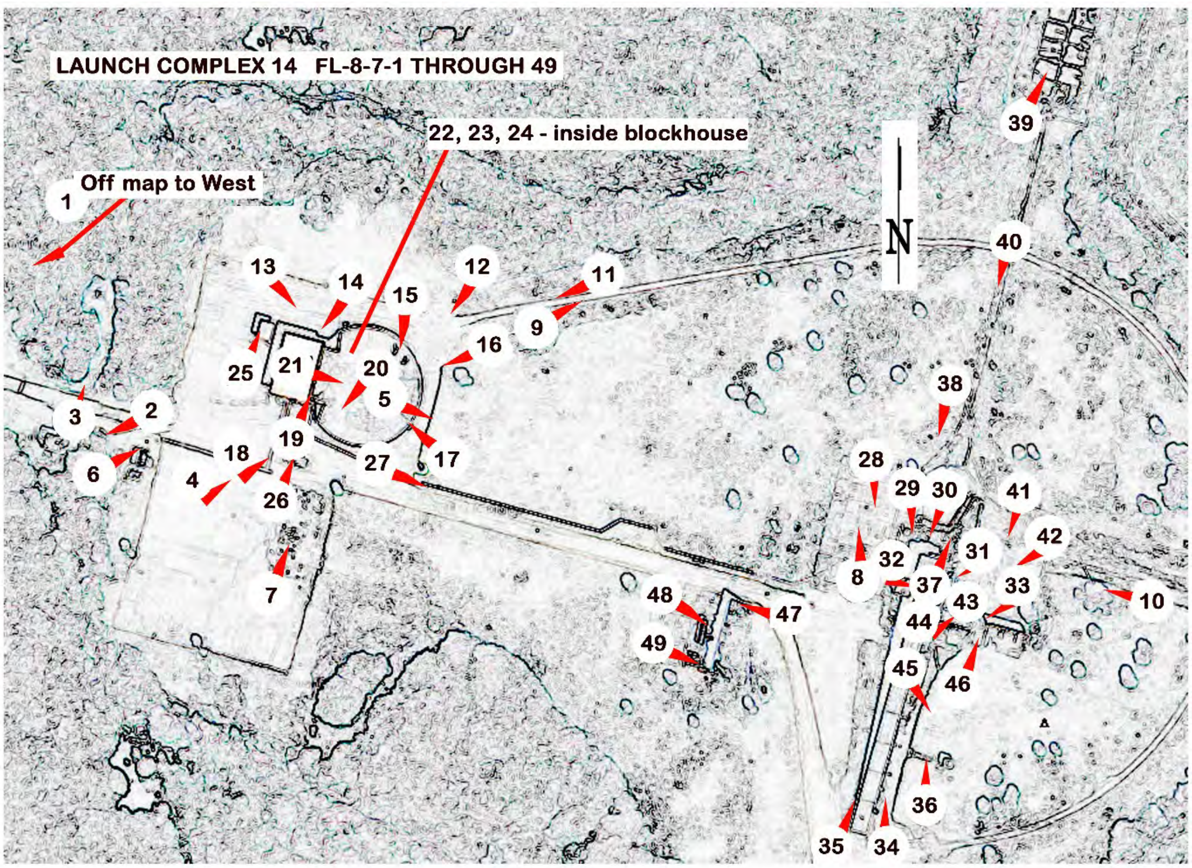
Photographer: Martin Stupich, 2014
See photo key on page 2 of Index to Photographs

FL-8-7-C-1	SENTRY HOUSE, OBLIQUE VIEW SOUTHWEST TO NORTHEAST (on photo key as #26)



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East side of ICBM Road
Cape Canaveral
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Photographer: Martin Stupich, 2014
See photo key on page 3 of Index to Photographs

FL-8-7-D-1	STEEL PLATES COVERING CABLEWAY BETWEEN BLOCKHOUSE AND LAUNCH STAND/RAMP, VIEW TO WEST (on photo key as #27)
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FL-8-7-D-3	LAUNCH STAND, VIEW TO SOUTHEAST (on photo key as #29)
FL-8-7-D-4	LAUNCH STAND FROM NORTH (“DOWN-BLAST”) DELUGE CHANNEL SHOWING, AT CENTER BOTTOM, DELUGE PIPES SHORN OFF AT GRADE (on photo key as #30)
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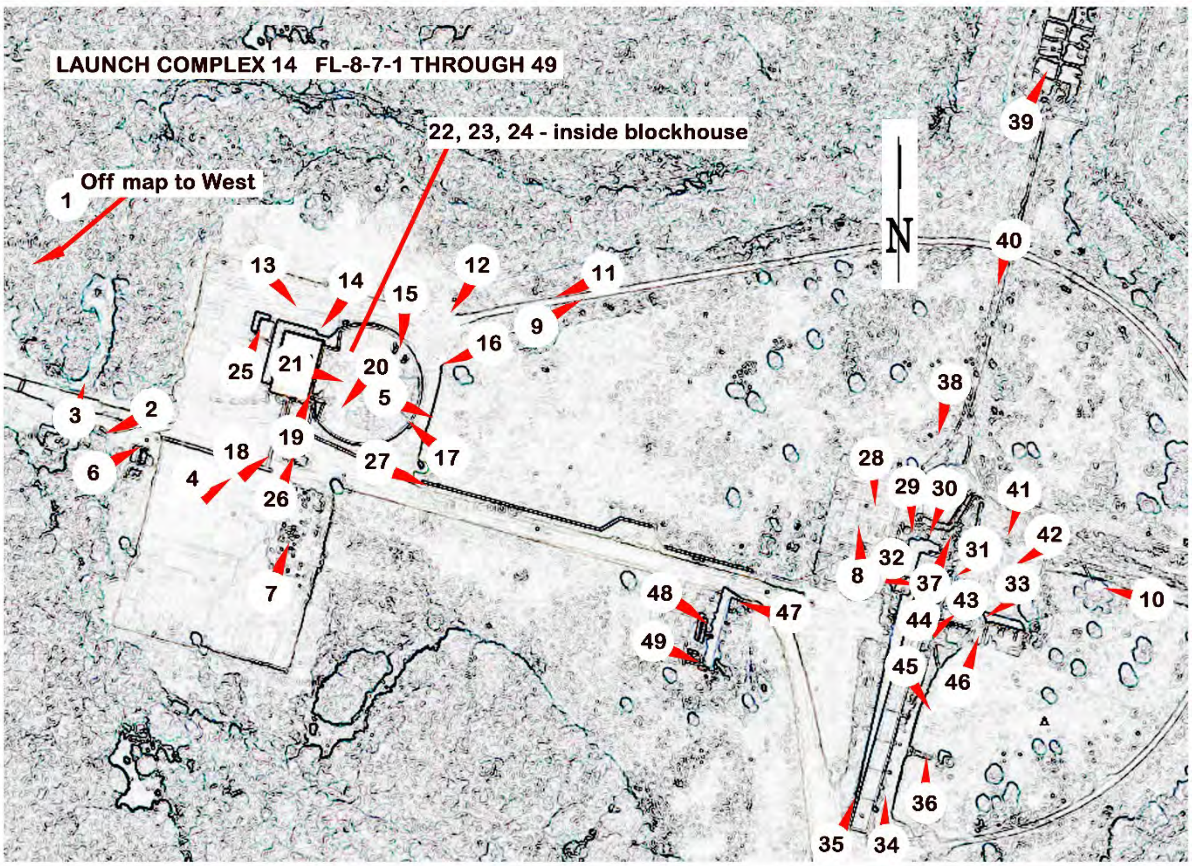
FL-8-7-D-6	FROM WEST SIDE OF DELUGE BASIN, TOWARD LAUNCH STAND; VIEW TO SOUTH (on photo key as #38)

FL-8-7-D-7	VIEW OF NORTH END OF LAUNCH STAND AND RAMP SHOWING STEEL PLATES AND TORCH-CUT FOOTINGS OF LAUNCH STAND (REMOVED), VIEW TO SOUTHWEST (on photo key as #31)
FL-8-7-D-8	WEST END OF LAUNCH STAND TO NORTHEAST (on photo key as #32)
FL-8-7-D-9	STAIRS AND PLATFORM AT SITE OF FORMER UMBILICAL TOWER; VIEW TO SOUTHWEST (on photo key as #33)
FL-8-7-D-10	GENERAL VIEW FROM SOUTH END OF RAMP TO NORTH, WITH MERCURY MEMORIAL MONUMENT NEAR END OF RAMP (on photo key as #34)
FL-8-7-D-11	CLOSE VIEW, SOUTH END OF RAMP TO NORTH WITH MERCURY MEMORIAL MONUMENT NEAR END OF RAMP (on photo key as #35)
FL-8-7-D-12	EAST SIDE OF RAMP SHOWING RAMP AND PROPELLANT TRANSFER UNIT BUILDING, VIEW TO NORTH (on photo key as #36)



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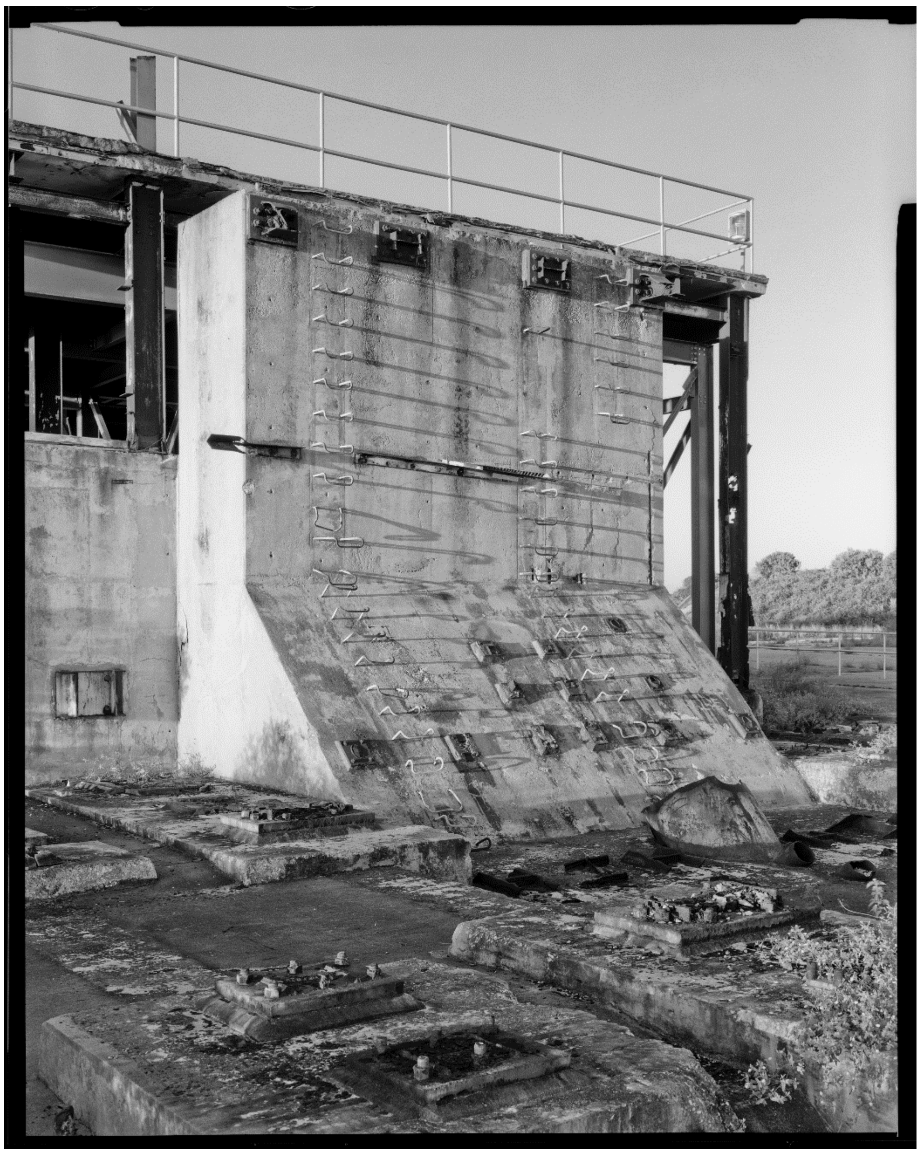

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East side of ICBM Road
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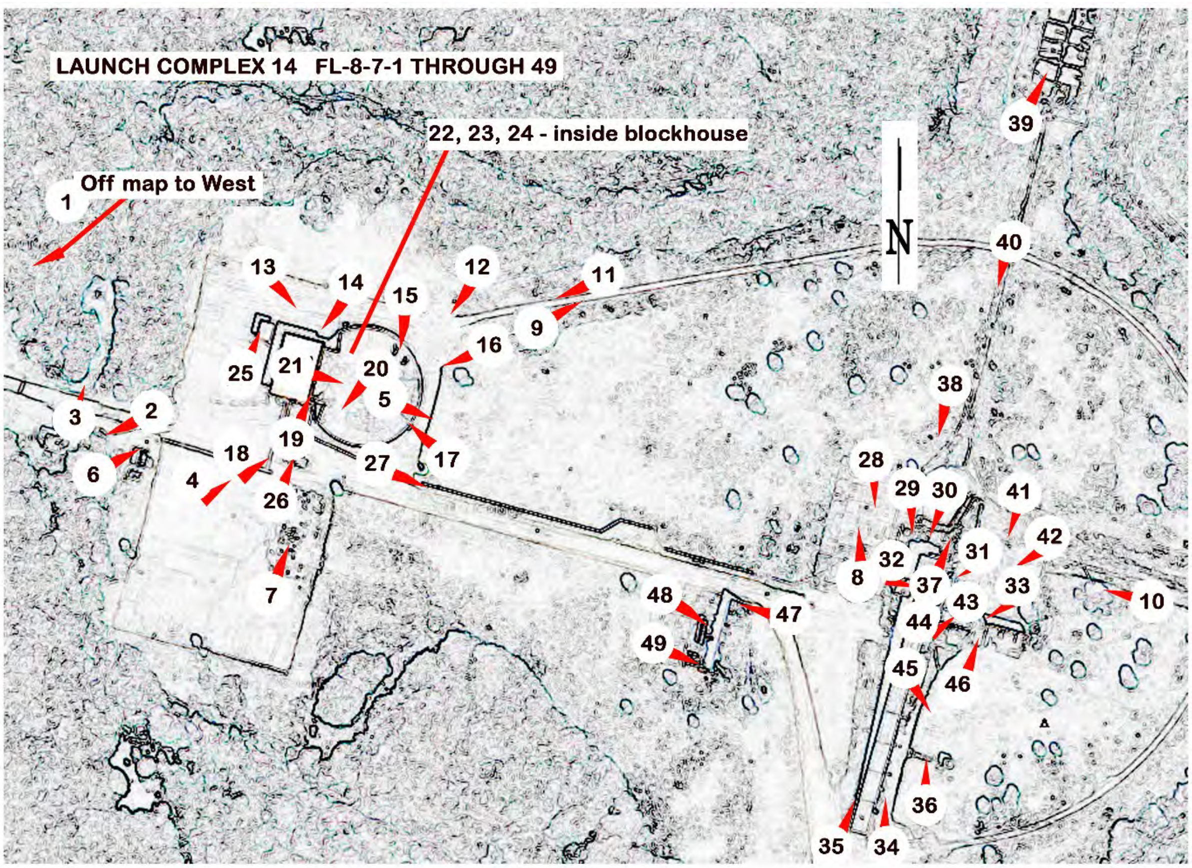
Photographer: Martin Stupich, 2014
See photo key on page 2 of Index to Photographs

FL-8-7-E-1	SKIMMING BASIN FROM SOUTH SIDE, VIEW TO NORTH (on photo key as #39)
FL-8-7-E-2	FLUME BETWEEN SKIMMING BASIN AND LAUNCH STAND; VIEW TO NORTH (on photo key as #40)



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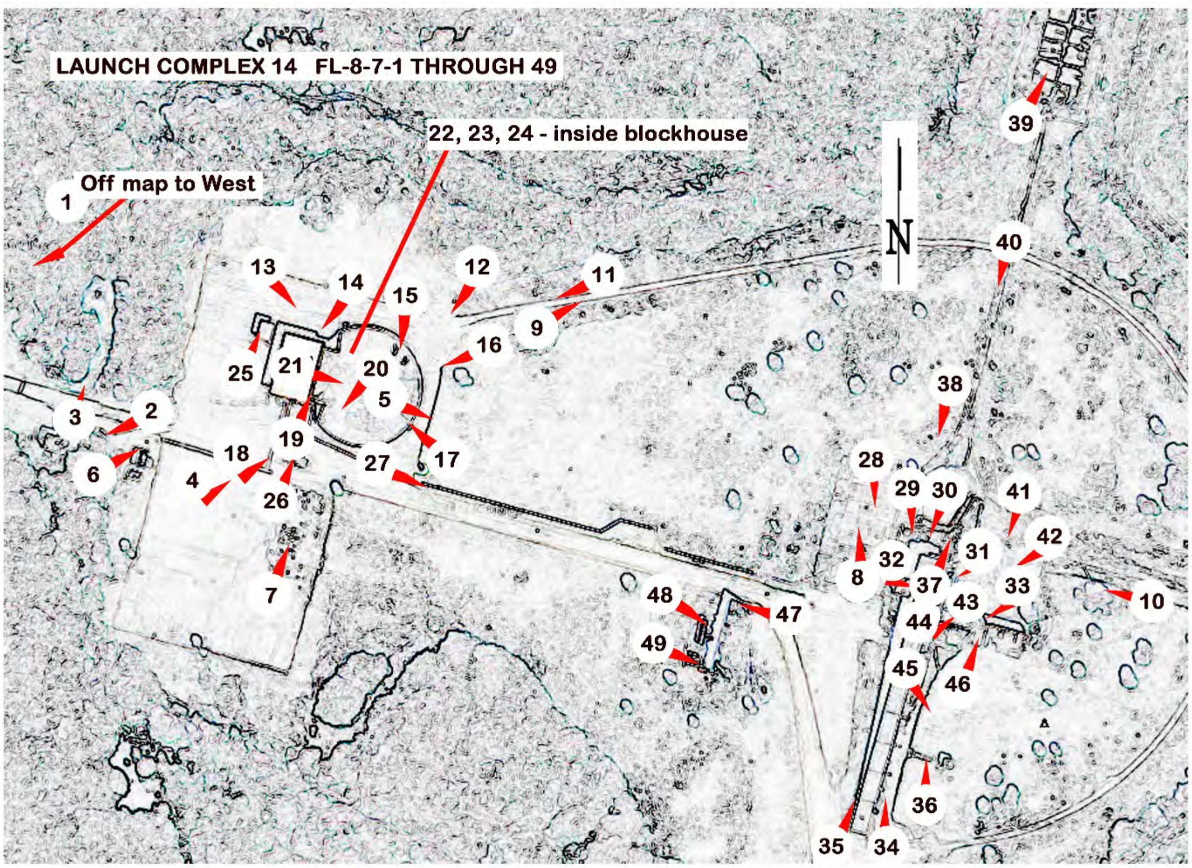
Photographer: Martin Stupich, 2014
See photo key on page 2 of Index to Photographs

FL-8-7-F-1	EAST SIDE OF LAUNCH STAND SHOWING JP-4 STORAGE AREA AND BLAST WALL AND PROPELLANT TRANSFER UNIT BUILDING, VIEW TO SOUTH (on photo key as #41)
FL-8-7-F-2	GENERAL VIEW OF NORTH END OF LAUNCH STAND AND RAMP WITH PROPELLANT TRANSFER UNIT BUILDING, VIEW TO SOUTHWEST (on photo key as #42)
FL-8-7-F-3	INTERIOR OF PROPELLANT TRANSFER UNIT BUILDING, VIEW TO NORTHWEST (on photo key as #43)
FL-8-7-F-4	PROPELLANT TRANSFER UNIT BUILDING FROM UNDER RAMP; VIEW TO NORTHEAST (on photo key as #44)



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Photographer: Martin Stupich, 2014
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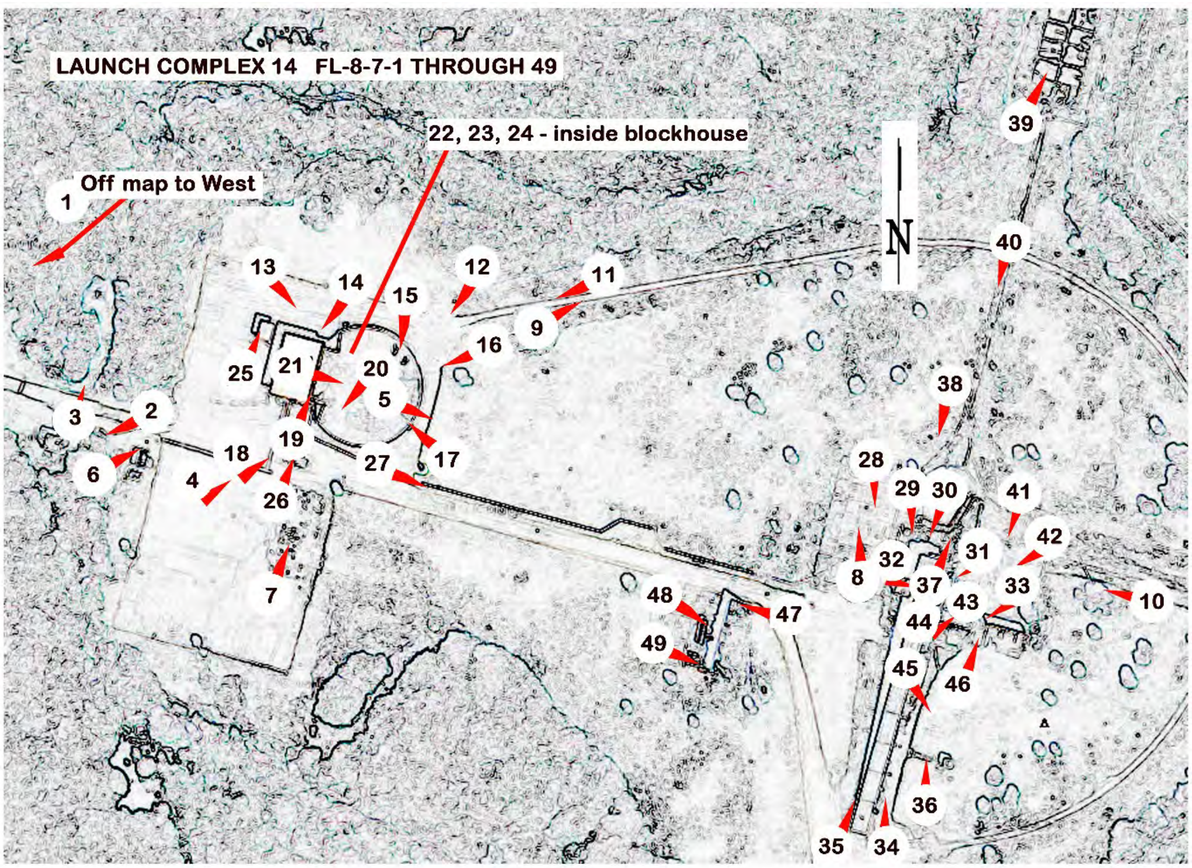
FL-8-7-G-1	PETROLEUM, OIL, AND LUBRICANTS STORAGE BUILDING FROM RAMP, VIEW TO SOUTHEAST (on photo key as #45)
FL-8-7-G-2	PETROLEUM, OIL, AND LUBRICANTS STORAGE BUILDING WITH JP-4 STORAGE AREA BLAST WALL BETWEEN RAMP AND PETROLEUM, OIL, AND LUBRICANTS STORAGE BUILDING, VIEW TO NORTH (on photo key as #46)



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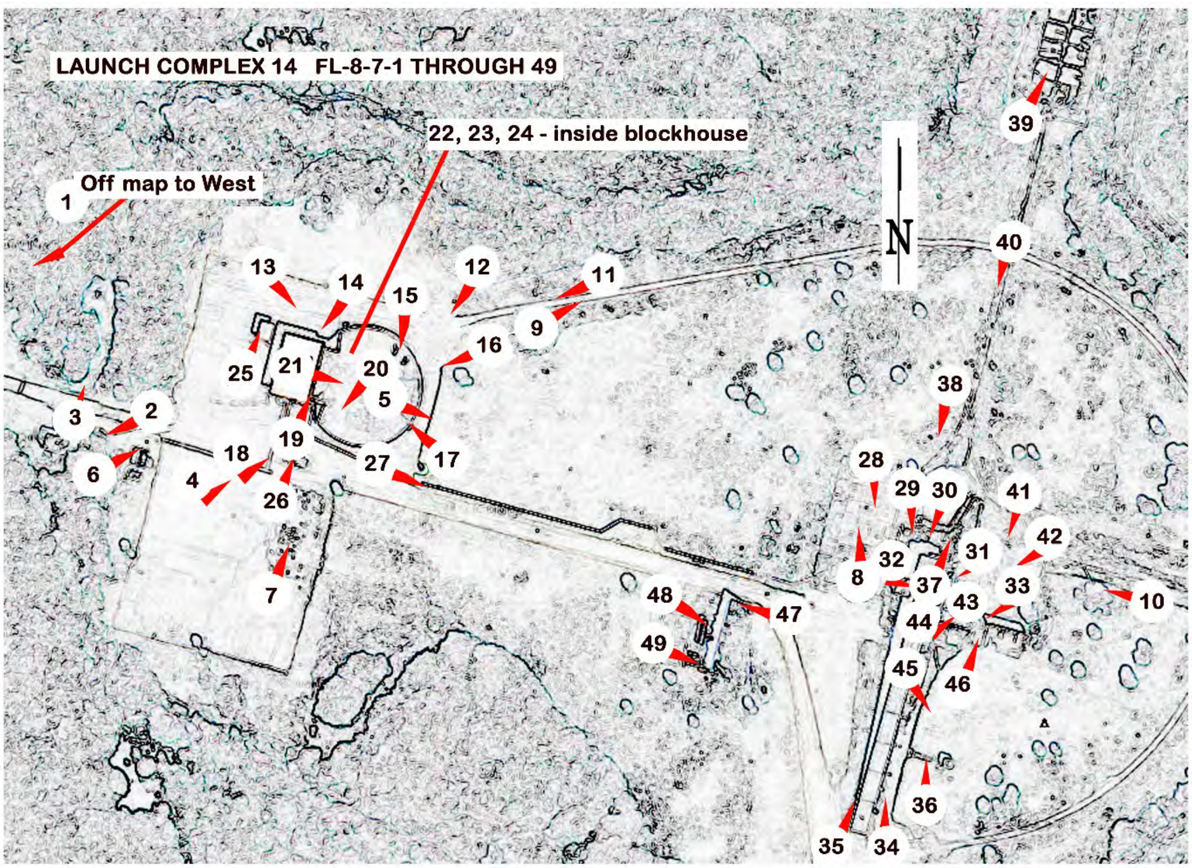
East side of ICBM Road
Cape Canaveral
Brevard County
Florida

INDEX TO BLACK AND WHITE PHOTOGRAPHS

Photographer: Martin Stupich, 2014
See photo key on page 2 of Index to Photographs

FL-8-7-H-1	VIEW WEST FROM TOP OF RAMP SHOWING LIQUID OXYGEN/ GASEOUS NITROGEN STORAGE AREA BLAST WALL, CABLEWAY WALL AND BLOCKHOUSE; VIEW TO WEST (on photo key as #47)
FL-8-7-H-2	LIQUID OXYGEN/GASEOUS NITROGEN STORAGE AREA BLAST WALL AND TANK (NOT IN ORIGINAL POSITION), VIEW TO SOUTHEAST (on photo key as #48)
FL-8-7-H-3	FOUNDATIONS OF TANK SUPPORTS (NOTE SCALE IN FOREGROUND), LIQUID OXYGEN/GASEOUS NITROGEN STORAGE AREA; VIEW TO EAST (on photo key as #49)



Photograph Key for Entire Complex.

HISTORIC AMERICAN ENGINEERING RECORD
CAPE CANAVERAL AIR FORCE STATION
LAUNCH COMPLEX 14
SEE INDEX TO PHOTOGRAPHS FOR CAPTION
HAER No. FL-8-7-H-1

HISTORIC AMERICAN ENGINEERING RECORD
CAPE CANAVERAL AIR FORCE STATION
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HISTORIC AMERICAN ENGINEERING RECORD

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CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 14, FACILITY No.10915 — HAER No. FL-8-7-I
(LAUNCH COMPLEX 14, WATER DEMINERALIZATION STATION)
East side of ICBM Road
Cape Canaveral
Brevard County
Florida

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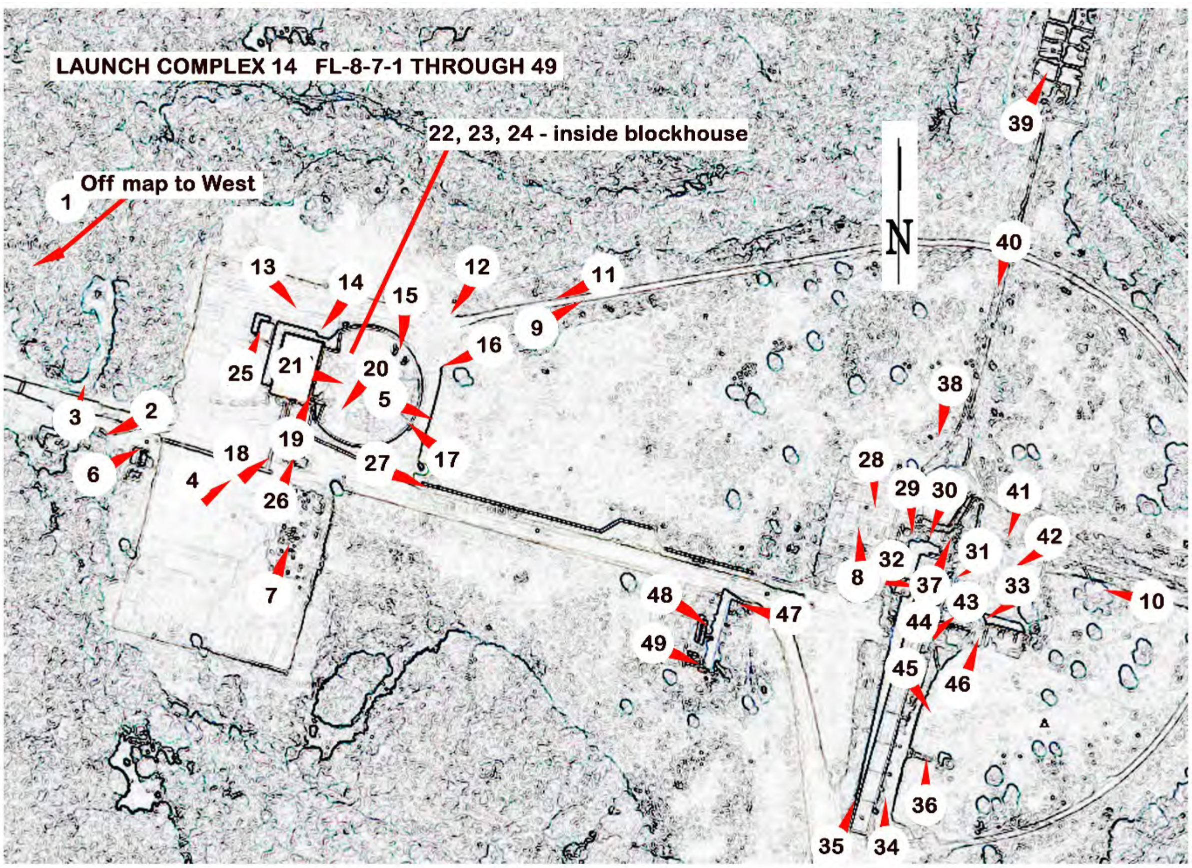
Photographer: Martin Stupich, 2014
See photo key on page 2 of Index to Photographs

FL-8-7-I-1	WATER DEMINERALIZATION STATION/ COMPRESSOR BUILDING, VIEW TO WEST (on photo key as #2)



Photograph Key for Entire Complex.

HISTORIC AMERICAN ENGINEERING RECORD
CAPE CANAVERAL AIR FORCE STATION
LAUNCH COMPLEX 14
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CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 34
17251 Freedom Road
Cape Canaveral
Brevard County
Florida

HAER No. FL-8-6

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
Southeast Regional Office
National Park Service
U.S. Department of the Interior
Atlanta, Georgia 30303

HISTORIC AMERICAN ENGINEERING RECORD

CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 34

HAER No. FL-8-6

Location:	17251 Freedom Road Cape Canaveral Brevard County Florida USGS Cape Canaveral Quadrangle, Universal Transverse Mercator Coordinates: 17.542938.3155150
Date of Construction:	1959-1961
Engineer/Architect:	Maurice H. Connell & Associates, Inc., Rader and Associates, and Pan American World Airways, Inc.
Present Owner:	United States Air Force (USAF)
Present Use:	Vacant
Significance:	Launch Complex 34 at Cape Canaveral Air Force Station (CCAFS) was built (1959–1961) to support the Saturn and Apollo programs. All Saturn I test flights launched from Complex 34. The complex was modified (1963–1965) for the Saturn IB. Launch Complex 34 was the site of the Apollo 1 fire in January 1967 that took the lives of three astronauts. In October 1968, the first manned Apollo flight launched from Complex 34. As one of the primary Saturn testing facilities, Launch Complex 34 played a pivotal role in the Apollo program. The development of the larger, more powerful Saturn V required the construction of Launch Complex 39 at Kennedy Space Center. Launch Complex 34 was deactivated in 1971 and abandoned in place in 1973.
Report Prepared by:	Kimberly Hinder Architectural Historian, Archaeological Consultants, Inc. 8110 Blaikie Court, Suite A, Sarasota, Florida 34240 Updated – Dr. Susan Enscore U.S. Army Engineer Research and Development Center Construction Engineering Research Laboratory 2902 Newmark Drive, Champaign, IL 61822
Date:	June 2003 (updated by Dr. Enscore April 2016)

HISTORICAL OVERVIEW OF CAPE CANAVERAL AIR FORCE STATION

Rocketry in the United States originated with the pioneering work of Robert H. Goddard, who launched the first liquid-propelled rocket in 1926. Across the Atlantic, German engineers were simultaneously developing their own rocket science program. Encouraged by the Nazi regime during World War II, the Germans developed the V-1 "buzz bomb" and the V-2 ballistic missiles, which they used against Allied cities in 1944. Although the Allied forces had experimented with missiles powered by rocket engines, they lacked the technology to compete with the V-2, against which there was little defense. As a result, the U.S. Army, Navy, and U.S. Air Force (USAF) each initiated their own missile programs to fulfill their particular roles in national defense.

Following the war, the U.S. Army brought 115 German rocket engineers and scientists, including Dr. Wernher von Braun, to the United States to develop their program. These engineers conducted experiments to refine the German V-2 and develop long-range surface-to-surface guided missiles. Initially stationed at Fort Bliss, Texas, the team assisted the Army in testing rockets at the White Sands Proving Grounds beginning in May 1946. This site, however, was geographically constrained and posed a danger to civilians when rockets misfired.[1]

Increasingly concerned with Soviet missile and nuclear development after World War II, the Department of Defense created and charged the Committee on Long Range Proving Grounds to select a suitable missile test site in October 1946. Cape Canaveral was selected for several critical reasons. Missiles could be launched over the Atlantic Ocean and tracked from islands. The isolated location of the Cape enhanced security for research and development. The government already owned land at the Cape, and the undeveloped nature of the remaining land made it less expensive to acquire. The launch area was accessible via water, easing the transportation logistics of heavy rockets and building supplies. The warm weather also allowed year-round operation of a missile site at the Cape.[2]

In 1949, President Harry S. Truman signed legislation which established the Joint Long Range Proving Ground at Cape Canaveral, with Patrick USAF Base (originally the Banana River Naval

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[1] Charles D. Benson and William B. Faherty, *Moonport: A History of Apollo Launch Facilities and Operations* (National Aeronautics and Space Administration, Scientific and Technical Information Office, 1978; reprint as *Gateway to the Moon: Building the Kennedy Space Center Launch Complex* and *Moon Launch! A History of the Saturn-Apollo Launch Operations*, Gainesville: University Press of Florida, 2001), 1 (page references are to reprint edition).

[2] David Barton and Richard S. Levy, *An Architectural and Engineering Survey and Evaluation of Facilities at Cape Canaveral Air Force Station, Brevard County, Florida* (Resource Analysts, Inc., 16 March 1984), 3-4; Benson and Faherty, 4.

Air Station) selected as the support base. Although the entire facility was initially under the cooperative use of the Army, Navy, and USAF, by a directive of the Department of Defense, the USAF ultimately assumed responsibility for the range. The Joint Long Range Proving Ground was renamed the Air Force Missile Test Center, the first of many subsequent name changes. Although the Army continued its operation of the White Sands Proving Grounds in New Mexico and the Navy continued to fund its missile testing center at Point Mugu, California, both military branches continued to play an active role at Cape Canaveral.[3]

Construction and Missile Development at Cape Canaveral

Between April and June of 1950, land was acquired at the Cape through negotiation and condemnation proceedings. During this period, the United States Army Corps of Engineers was designated as the construction agency. The Jacksonville District of the Corps opened an office at Patrick Air Force Base in 1950 to oversee construction at Patrick Air Force Base and the Air Force Missile Test Center at Cape Canaveral. By December 1950, the office had managed $2.4 million of construction contracts. For each construction project, the agency (Army, Navy, or USAF) would submit project specifications, a deadline for completion, and authorization to begin construction to the Corps. The Corps would then negotiate and award a contract to an architectural/engineering firm for preparation of the construction plans. Once the plans were submitted, the Corps advertised and selected a contractor who was required to complete the project within the time frame or pay penalties.[4]

As the United States entered peacetime and reduced military funding during the late 1940s, the various branches of the military sought to determine their roles in missile research and design. The Army continued refining the German V-2, with the assistance of the team led by Wernher von Braun and 300 carloads of V-2 missile components seized during World War II. The Army conducted the first successful launch at Cape Canaveral on July 24, 1950. An Army-General Electric Corporation-California Institute of Technology team launched Bumper No. 8, a modified V-2 rocket, from Launch Pad 3. The Army team continued to use Pad 3 to conduct additional launches through 1951.[5]

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[3] E.R. Bramlitt, *History of Canaveral District 1950-1971*, (South Atlantic Division, US Army Corps of Engineers, 1971), 1-2; Benson & Faherty, 3, 7.

[4] Bramlitt, 1-2, 33.

[5] Benson & Faherty, 1, 6-7.

During the late 1940s and early 1950s, USAF activities at Cape Canaveral focused on winged cruise missile research and development as a deterrent force in the weapons race between the United States and the Soviet Union. Constrained by a reduced budget, the USAF chose to fund research and testing on the cruise missile, projected to be operational before the ten years anticipated for the development of the ballistic missile. These winged missiles resembled unmanned airplanes and fell into four different categories: air-to-air, air-to-surface, surface-to-air, and surface-to-surface. These missiles were restricted to the Earth's atmosphere because they required oxygen for engine combustion. The earliest launch pads, used for firing experimental winged missiles including the Lark, Matador, Snark, Bomarc, Bull Goose, and Mace, were located at the tip of the Cape, and included Launch Complexes 1-4, 9/10, and 21/22. Support buildings, including a communications building, a water plant, a fire-fighting unit, electrical substations, a skid strip for the landing and reuse of the missiles, and Hangars C and O, were constructed near the original launch pads. As explosive power increased, and missiles necessarily grew larger, support activities were relocated farther from the launch pads to an Industrial Area which was situated along the western shore of the Cape.[6]

After the Soviets detonated their first atomic device in 1949, and following the outbreak of war in Korea in 1950, the United States government reassessed the military cutbacks of the late 1940s. With increased funding and the development of relatively lightweight nuclear warheads, the USAF and Army decided to pursue ballistic missile research and development. Faster and more accurate than the winged cruise missiles, ballistic missiles, with their own oxygen source, could leave the Earth's atmosphere. The ballistic missiles were divided into two categories based on the distance they could travel. The intercontinental ballistic missiles (ICBM) had a range of over 5,000 miles. Intermediate range ballistic missiles (IRBM) had a range of 1,500 miles. The USAF, which remained focused primarily on the development of cruise missiles, initiated a ballistic missile study which resulted in the Atlas missile.[7]

To advance its research and development of ballistic missiles, the Army Ballistic Missile Agency moved their team of German engineers from Fort Bliss, Texas, to the Redstone Arsenal in Huntsville, Alabama. Soon after the move to Huntsville, the launch team, known as the Missile Firing Laboratory (MFL), established facilities at Cape Canaveral. With the first launch of the Redstone missile on August 20, 1953, at Launch Pad 4, the MFL inaugurated the testing of

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[6] Barton and Levy, 6, 25; Bramlitt, 5-8; Jacob Neufeld, *The Development of Ballistic Missiles in the United States Air Force, 1945*-1960, (Washington, D.C.: Office of Air Force History, United States Air Force, 1990), 239.

[7] Neufeld, 98, 241; Benson and Faherty, 1, 3, 7.

ballistic missiles, an event which foreshadowed the construction of numerous launch facilities for ballistic missiles at the Cape.[8]

Both the detonation of the first thermonuclear device in 1952 and intelligence reports indicating that the Soviet Union was developing long-range missiles and thermonuclear warheads led to advancements in ballistic missile development. In 1953, the USAF formed a panel of U.S. scientists to examine their Snark, Navaho, and Atlas missile programs. The panel recommended accelerating development of the Atlas ICBM.[9] By 1955, USAF officials convinced President Eisenhower to assign the ICBM development program the highest national priority. Accordingly, the USAF initiated programs for the design and testing of the ICBM Titan in 1955 and the ICBM Minuteman in 1958. As the USAF ICBM program grew, intelligence reports indicated that the Soviet Union would have ICBMs with nuclear warheads operational by 1960. Fearing that the United States could not match the Soviet ICBM threat, the Department of Defense decided to fund the development of IRBMs because they would be operational sooner and would act as a deterrent based out of Europe. In 1955, the Department of Defense approved two IRBM programs, the USAF Thor and the Army/Navy Jupiter, which developed simultaneously and were assigned an equal national priority as the ICBM programs.[10]

The constant drive to develop more accurate and powerful weapons during the Cold War led to the construction of numerous launch complexes along the Cape. Although many of the early launch complexes were adapted to new uses as support structures, complexes constructed for one type of missile were rarely reused to launch another type of missile because they were not configured structurally, electronically, or for safety concerns for the new larger and more powerful missile. Economically, it was more cost effective to design and build a new complex than to reconfigure and adapt an old complex. Explosive hazards, the dangers of launching over other complexes or inhabited areas, and maintaining a line of site between the launch vehicle and the launch control center (blockhouse) determined the choice of sites and distance between launch complexes. Each missile had similar ground requirements at the launch complex including a launch pad, a gantry service tower, a blockhouse for on-site command and control of

[8] Benson and Faherty, 1, 3, 7.

[9] Neufeld, 98-103; David N. Spires, “The Air Force and Military Space Missions: The Critical Years, 1957-1961,” in *The U.S. Air Force in Space: 1945 to the 21st Century*, Proceedings Air Force Historical Foundation Symposium, Andrews AFB, Maryland, September 21-22, 1995, ed. R. Cargill Hall and Jacob Neufeld (Washington, DC: USAF History and Museums Program, United States Air Force, 1998), 34-35.

[10] ibid., 143-48, 241-2.

the launch, and a network of power, fuel, and communication links.[11] The government maintained programs for both ICBMs and IRBMs concurrently, and facilities for both types of missiles were constructed at Cape Canaveral. Over time, the area south of the tip was developed for launching IRBMs (Redstone, Pershing, Polaris/Poseidon, and Thor) and included Launch Complexes 5/6, 17, 18, 25, 26, 29, and 30). The area north of the tip was developed for launching ICBMs and space launch vehicles (Atlas, Titan, Saturn) and included Launch Complexes 11-16, 19, 20, 34, 36, and 37.[12]

Throughout the early and mid-1950s, the focus of activities at Cape Canaveral remained on missile development for defense against the Soviets. In November 1956, the Secretary of Defense divided the responsibilities for research and development of missiles among the armed forces. The USAF received responsibility for all intermediate and long-range missiles, both IRBMs and ICBMs, while the Army was restricted to missiles with a range of 200 miles or less. The Navy was limited to developing submarine and ship-based IRBM missile systems.[13]

Cape Canaveral and the United States Space Program

In 1955, President Eisenhower announced that the United States would launch an unmanned satellite as part of the nation's participation in the International Geophysical Year which extended from July 1957 through December 1958. The Army, Navy, and USAF immediately initiated planning for their own satellite programs.[14] When the Soviets launched the satellite Sputnik I in October of 1957, the attention of the public turned to space exploration. The following month, the Soviets placed the Sputnik II satellite carrying a dog into orbit around the Earth. The launch caused a furor among Americans who feared that the U.S. was losing not only the "space race," but also that a "missile gap" existed between the U.S. and the Soviets, who it was believed had hundreds of operational ICBMs. The President initially assigned responsibility for the U.S. space program to the Department of Defense. The Army's Development Operations Division led by

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[11] Benson and Faherty, 8-10.

[12] Barton and Levy, 4, 9; Denise P. Messick, Cynthia G. Rhodes, and Charles E. Cantley, *45th Space Wing Cultural Resource Management Plan*, Technical Report No. 386 (Stone Mountain, Georgia: New South Associates, 1996), 95; James N. Gibson, *Nuclear Weapons of the United States: An Illustrated History* (Atglen, PA: Schiffer Publishing, Ltd., 2000); Hartmann 2003.

[13] Neufeld, 242; Barton and Levy, 17.

[14] R. Cargill Hall, "Civil-Military Relations in America's Early Space Program," in *The U.S. Air Force in Space: 1945 to the 21st Century*, Proceedings Air Force Historical Foundation Symposium, Andrews AFB, Maryland, September 21-22, 1995, ed. R. Cargill Hall and Jacob Neufeld (Washington, DC: USAF History and Museums Program, United States Air Force, 1998), 25.

Wernher von Braun shifted their focus to the use of missiles to propel payloads, or even a man, into space.[15] After several failures on the launch pad, the United States entered the space race with the launch of the Army's scientific satellite Explorer I on January 31, 1958 using a four stage Jupiter C missile named Juno I. With the threat of a growing fleet of operational Soviet ICBMs, the branches of the U.S. military initiated the development of photographic reconnaissance satellites which were operational by 1960.[16]

Realizing that the military's involvement in the space program would jeopardize the goal of using space for peaceful purposes, the President's Science Advisory Committee urged that a centralized agency be created to oversee the scientific exploration of space. The new agency, the National Aeronautics and Space Administration (NASA), established October 1, 1958, was to be a civilian agency with the mission of carrying out scientific aeronautical and space exploration, both manned and unmanned. The Department of Defense, especially the USAF, would continue with defense related missile and satellite development.[17] Soon after the creation of NASA, Navy personnel and facilities associated with Project Vanguard and over 400 scientists from the Naval Research Laboratory were reassigned to NASA. The California Institute of Technology's Jet Propulsion Laboratory, affiliated with the Army, was also transferred to NASA. Initially working with NASA as part of a cooperative agreement, President Eisenhower officially transferred a large portion of the Army's Development Operations Division with the team led by Wernher von Braun to NASA in March 1960. At the same time, Eisenhower named the Huntsville NASA installation the Marshall Space Flight Center, and designated the MFL at Cape Canaveral as the Launch Operations Directorate of NASA. The Launch Operations Directorate, led by Dr. Kurt Debus, managed the overall integration, testing, and the launch operations of NASA.[18]

NASA soon organized a National Launch Vehicle Program to identify and analyze which missiles would be the most effective in exploring space. As a result, the Scout, Thor (Delta), Atlas, Titan, and Saturn, and modified versions of these rockets, were selected as boosters for manned and unmanned missions. Unmanned activities have included suborbital, orbital, and lunar satellite and vehicular missions to gather scientific information often relating to physics and astronomy. Although some were conducted to prepare for manned launches, most of the

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[15] Benson and Faherty, 1-2.

[16] ibid.

[17] Hall, 30; Barton and Levy, 20; Spires, 39.

[18] Spires, 39; Benson and Faherty, 15.

missions were intended simply to gain scientific knowledge with which to better understand Earth.[19]

Already upstaged by the Soviets, one of NASA's first goals was to put a man in orbit around the Earth. At its creation, the USAF's manned space projects were transferred to NASA, which NASA combined under the name Project Mercury in December 1958. NASA selected the first seven astronauts for the manned space program in April 1959. The goals of Project Mercury included sending a man into space to orbit the Earth, testing his ability to perform in a weightless environment, and to recover both man and capsule.[20] The program included two manned suborbital flights powered by a modified Redstone missile and four manned orbital flights powered by an Atlas missile topped by the Mercury capsule. The first suborbital flight occurred on January 31, 1961 with the launch of Ham, a chimpanzee. The United States was again upstaged when the Soviet Union launched Vostock I with cosmonaut Uri Gagarin to orbit the Earth in April 1961. The launch of Alan Shepard the following month on a Mercury suborbital flight proved anticlimactic.[21]

Realizing the impact of the Soviet advancements on the American psyche, President John F. Kennedy appointed Vice President Lyndon Johnson, in cooperation with representatives from NASA and the associated industries, to develop a space program that would surpass the Soviet program. The panel recommended a ten-year phased approach which would include manned space flight, planetary exploration, and the development of new rockets and satellites. Accepting the recommendations, President Kennedy presented the following before a joint session of Congress on May 25, 1961:

> I believe this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the Moon and returning him safely to the Earth. No single space project in this period will be more impressive to mankind, or more important for the long-range exploration of space, and none will be so difficult or expensive to accomplish.[22]

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[19] Barton and Levy, 20-27.

[20] Spires, 39; *Exploring Space...Project Mercury* (U.S. National Aeronautics and Space Administration) 3, Kennedy Space Center Archives, Kennedy Space Center, Sweetsir Collection 95-15, Box 12.

[21] Harry Butowsky, "Man in Space (Reconnaissance Survey) 1903-1981," (Denver: National Park Service, 1981), 4.

[22] ibid., "Man in Space," 4-5.

With widespread support, the public and Congress embraced the goal and the program proceeded rapidly. Circling the Earth three times, John Glenn completed the first manned orbital flight of the United States on February 20, 1962 in a capsule propelled by an Atlas rocket from Launch Complex 14. Followed by three more manned orbital flights, the Mercury program concluded as a success on May 15, 1963.[23]

NASA initiated planning for Project Gemini in late 1961 as the intermediate step in sending a man to the moon. Officially announced in 1962, the project was operational by 1964. The goals of Project Gemini included testing man's performance during extended periods in space, both within and outside of the spacecraft, development of rendezvous and docking techniques, and perfection of controlled reentry and landing techniques. The larger, more maneuverable capsule, designed to hold two men, was propelled by a Titan II rocket. Following the first unmanned Gemini launch on April 8, 1964, Gemini 3 was the first manned flight of the program in March 1965. Gemini 12, launched in November 1966, successfully completed the program.[24]

Apollo, the final step in landing astronauts on the moon, immediately followed Project Gemini. Studies to build the Saturn rocket, which would propel man to the moon, actually started in 1957 with the team led by Wernher von Braun under the Army's jurisdiction.[25] Ten times more powerful than the Atlas rocket and twenty times more powerful than the Jupiter, the size and power of the Saturn required the construction of Launch Complexes 34 and 37 at Cape Canaveral. Test flights of the Saturn rocket started at Launch Complex 34 in October 1961. In January 1962, NASA announced that the Saturn would be the moon launch vehicle. The goal of Apollo was to launch a team of three astronauts into orbit around the moon. While one astronaut remained in orbit, the others would then take an attached spacecraft to land on the moon and then redock with the primary vessel before returning to Earth. The initial missions were Earth orbital (unmanned and manned) followed by lunar missions to orbit and, later, land on the moon.[26]

NASA utilized Launch Complexes 34 and 37 for research and development of the Saturn rocket. Continued modifications to the Saturn to increase its power to propel man to the moon led to a larger rocket with new blast and acoustic hazards. With these factors in mind, combined with the

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[23] Barton and Levy, 28.

[24] Ibid., 28-30; William A. Lockyer, Jr., *A Summary of Major NASA Launchings: October 1, 1958-September 30, 1973,* KSC Historical Report No. 1 (John F. Kennedy Space Center: KSC Historical Services, 1973), IX-1-8.

[25] Benson and Faherty, 1-2.

[26] ibid., 37, 60-64; Barton and Levy, 30-31.

stepped-up launch schedule necessary to land a man on the moon by the end of the decade, it was apparent by 1961 that the Apollo program required a new launch complex.[27] Cape Canaveral, with over 22 launch complexes, did not have room for another complex. NASA officials solved the dilemma by acquiring land on Merritt Island, west and north of the existing missile launching area at the Cape. The first acquisitions of land started in 1962, with the majority under federal ownership by 1964. Initially known as the Merritt Island Launch Area, the land was acquired for use predominantly in support of the Manned Lunar Landing Program (Apollo) and was placed under NASA's exclusive jurisdiction. With the new facilities, NASA's offices at the Cape, led by Kurt Debus, expanded and relocated to the Merritt Island Launch Area. The newly independent installation, on par with Marshall Space Flight Center, was renamed the John F. Kennedy Space Center in November 1963 after the death of the president.[28]

During land acquisition and construction of the Kennedy Space Center, NASA continued manned space flight under the Mercury and Gemini programs and preparations for Apollo. During a simulation flight at Launch Complex 34, three astronauts, Virgil Grissom, Edward White, and Roger Chaffee, lost their lives in an oxygen fire in the cockpit on January 27, 1967. Apollo 4 (November 9, 1967) through Apollo 6 (April 4, 1968) were unmanned Earth orbital missions to test the Saturn rocket and the Command and Service modules. The October 11, 1968 Apollo 7 launch was the first manned Apollo launch which placed astronauts into Earth's orbit for a ten-day mission. Apollo 8, the first launch at the newly completed Kennedy Space Center, achieved the first lunar orbit in December 1968. The goal of landing man on the moon was achieved with Apollo 11 on July 20, 1969 and was followed by six additional lunar missions which gathered extensive scientific information culminating in Apollo 17 in December 1972. Subsequent manned space programs included the Skylab, Apollo-Soyuz, and the Space Shuttle, which took its inaugural flight on April 12, 1981. The Space Shuttle program ended on July 21, 2011.[29]

History of Complex 34

As the first of three launch complexes constructed at Cape Canaveral to serve the Apollo program, Launch Complex 34 played a significant role in the development of the Saturn missile necessary to achieve the goals of the Apollo program. The successful completion of the Apollo

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[27] Benson and Faherty, 65-68.
[28] ibid., 96-98, 105, 133-137, 146-48.
[29] Barton and Levy, 31; Butowsky "Man in Space," 5-6.

program brought an end to the fears that the United States was losing not only an “arms race,” but also a “space race,” with the Soviets. Launch Complex 34 proved pivotal in the development of the United States’ manned space program with the successful testing of all of the Saturn I Block I test flights, further testing of the Saturn IB, and the launch of Apollo 7, the first manned orbital flight of the mission. The Complex was also the site of the first NASA tragedy with the loss of Apollo 1 on the pad in January 1967. From 1961 to 1968, NASA launched seven space launch vehicles from Launch Complex 34.

Planning and development of the Saturn missile, and the construction of Launch Complex 34 (Figure 1), originated prior to the creation of the Apollo program. Following the launch of Sputnik I and Sputnik II which placed Soviet satellites into Earth’s orbit in 1957, the attention of the American public turned to space exploration. When the President initially assigned responsibility for the U.S. space program to the Department of Defense, the Army’s Development Operations Division of the Army Ballistic Missile Agency (ABMA) led by Wernher von Braun shifted their focus to the use of missiles to propel payloads, or even a man, into space. After several failures on the launch pad, the United States entered the space race with the launch of the Army’s scientific satellite Explorer I on January 31, 1958 using a modified Jupiter missile named Juno I. [30]

Developed by the design team led by von Braun, the Saturn family of rockets originated as part of the Juno missile program in 1957. The Redstone-based Juno I and Jupiter-based Juno II were already viable rockets, while the Juno III and Juno IV remained in the planning stages. Originally designated as Juno V, initial designs called for a rocket with a first stage composed of a cluster of eight Redstone missiles surrounding one Jupiter missile. Each of the clustered missiles would be fitted with a modified Thor engine produced by Rocketdyne. This nine-engine first stage would produce approximately 1.5 million pounds of thrust during liftoff. This pioneering design was the first to increase a rocket’s payload capacity by clustering existing missiles. In August 1958, the Advanced Research Projects Agency (ARPA) officially authorized ABMA to proceed with the development of a rocket with a clustered first stage. In October 1958, von Braun recommended renaming the Juno V because the rocket was markedly different from the Jupiter-based Juno family of rockets. He suggested the name of Saturn since the planet is the sixth from the sun following Jupiter, a name which ARPA approved in February 1959.[31]

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[30] Benson and Faherty, 1-2.

[31] Clifford J. Lethbridge, “Saturn I Fact Sheet,” Spaceline.org, Spaceline, Inc., 1998.

Realizing that the military's involvement in the space program would jeopardize the goal of using space for peaceful purposes, the President established NASA on October 1, 1958, as a civilian agency with the mission of carrying out scientific aeronautical and space exploration, both manned and unmanned. NASA soon organized a National Launch Vehicle Program to identify and analyze which missiles would be the most effective in exploring space. Although still under development, the potential power of the clustered rocket design of the Saturn led to its selection as one of the core boosters for space launch vehicles.[32] Initially working with NASA as part of a cooperative agreement, President Eisenhower officially transferred a large portion of the Army's Development Operations Division, along with the group of scientists led by von Braun and the Saturn rocket program, to NASA.[33]

While still in the design phase, the Saturn Vehicle Evaluation Committee composed of representatives from the USAF, NASA, ARPA, and ABMA met in order to determine the configuration and goals for the Saturn missile. Commonly known as the Silverstein Committee,[34] the group selected three initial missions for the Saturn vehicle: unmanned lunar and deep space missions with a 9,920-pound escape payload, a 24-hour equatorial orbit with a 4,960-pound payload, and manned spacecraft missions in low orbits. To achieve these goals, the committee recommended that NASA consider three different configurations utilizing the clustered first stage concept mated with several different upper stages. Of the three suggested configurations, known as Saturn A, Saturn B, and Saturn C; the Saturn C was selected. The concept included five versions of the missile, Saturn C-1 through Saturn C-5, ranging from the least to the most powerful. The Saturn C-1, which consisted of a two-stage vehicle closely resembling the original Juno V plans, was already under development (Figure 2). The Saturn C-2 would utilize the same first stage with an improved second stage and an added third stage. The Saturn C-3 through C-5 would be based upon the same configuration, but would employ varying numbers of more powerful Rocketdyne engines in the first stage. NASA selected the two-stage Saturn C-1 for Apollo research and development flights. Produced by Chrysler, which had also produced Redstone and Jupiter, the missile was ready for flight tests by 1961.[35]

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[32] Hall, 30; Barton and Levy, 20-27; Spires, 39.

[33] Benson and Faherty, 15; Spires, 39.

[34] Dr. Abe Silverstein, NASA's Director of Space Flight Development, led the committee.

[35] Benson and Faherty, 13-15; Lethbridge, "Saturn I Fact Sheet;" Chrysler was a contractor for the U.S. Army's Ordnance Guided Missile Center at Redstone Arsenal.

Following the approval of the development of the rocket in 1958, the USAF and NASA evaluated existing and proposed launch sites for the new missile. The size and explosive power of the Saturn required the construction of a new launch complex at Cape Canaveral. At the time Launch Complex 34 was conceived, only four test flights of the Saturn vehicle were planned and there was no timetable requiring a rapid series of launches. With no strong argument to justify the cost of a second launch pad, a single launch pad was constructed at Complex 34 (Figure 3). As a result, the maximum launch rate for the complex was four vehicles per year, allowing two months for vehicle checkout and one month for pad refurbishment between launches.[36]

Launch Complex 34 was constructed between June 1959 and June 1961. As the construction agency at Cape Canaveral, the U.S. Army Corps of Engineers let the contract for the construction of Complex 34 on June 3, 1959. Construction started five days later on June 8. Plans for the complex were prepared by Maurice H. Connell and Associates and Rader and Associates. The initial construction costs for the “brick and mortar” totaled $6,215,000. By 1966, the complex was valued at $25,340,000. Although the complex reached “beneficial occupancy” status in February 1961, construction was completed in July 1961 and officially approved by the Corps in January 1962. Complex 34 was the first of two launch complexes at Cape Canaveral completed for the Saturn I and Saturn IB program, with the first launch of a Saturn I missile from the complex at Cape Canaveral on October 27, 1961 (Figure 4).[37] This first flight produced the largest thrust of a United States launch vehicle up to that time. Significantly, Launch Complex 34 was the largest rocket launching site in the world, and the first built expressly for the peaceful exploration of space.[38]

The first four flights of the Saturn I were launched in the Block I configuration which consisted of a live first stage topped by a dummy upper stage composed of an inert Jupiter missile shell ballasted with water to provide aerodynamic stability. The live first stage consisted of eight Redstone stages, which acted as fuel tanks, surrounding one Jupiter missile, similar to the original design for the Juno V. Four of the Redstone stages and the Jupiter stage held liquid oxygen, while the remaining four Redstones contained RP-1.[39] The liquid oxygen and RP-1

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[36] “LC 34-37 Launch Complexes and Ground Support Equipment,” 1.

[37] Real Property Cards, Cape Canaveral Air Force Station; Eastern Test Range Launch Complexes, 1991; Cleary, Eastern Range Launches; Cleary, “45th Space Wing”; “LC-34/37 Phaseout Plan,” Prologue; Maurice H. Connell & Associates, Inc., Location & Vicinity Maps and Index to Drawings, 01-21900-081, 01-21900-047, 01-21900-048, 01-21900-047, 01-21900-050, 01-21900-051, 01-21900-086, 01-21900-100, 01-21900-101, U-34-A1, and U-34-A2; Rader and Associates, Drawings 01-21900-003, 01-21900-004, 01-21900-005; *Technical Facilities Catalog: Volume II*, 10-10.

[38] “Launch Complex 34 Facilities: Fact Sheet 05,” [2].

[39] RP-1 is a kerosene based rocket fuel.

combined to fuel eight Rocketdyne H-1 engines which powered the Saturn C-1. The Block I configuration was utilized to test the vehicle's compatibility with the launch facility, flight dynamics of the vehicle, and the reliability of the clustered first stage.[40]

In May 1961, President John F. Kennedy charged NASA and the associated industries to develop a space program that would surpass the Soviet program by landing a man on the moon by the end of the decade. With widespread support, the space program proceeded rapidly. In order to streamline and accelerate the program, NASA discontinued development of the Saturn C-2, C-3, and C-4, instead focusing on plans for the C-1, the uprated C-1 (also known as the IB), and the C-5. Three more test flights of the Saturn C-1 followed in April and November 1962 and March 1963, all from Launch Complex 34 (Figure 5). In February 1963, the "C" designation was dropped from the Saturn names, leaving simply the Saturn I, Saturn IB, and Saturn V.[41]

Following the successful first test flight of the Saturn I in October 1961, NASA announced that the family of Saturn vehicles would be the launch vehicles used in the Manned Lunar Landing Program (Apollo). Development and testing of rockets and complexes to implement the three stages in sending man to the moon, designated as Projects Mercury, Gemini, and Apollo, continued simultaneously. Apollo, the final step in landing astronauts on the moon, immediately followed the successful completion of Projects Mercury and Gemini. The goals of the Apollo program included a manned space flight of three astronauts to orbit the moon. While one astronaut remained in orbit, the other two would then take an attached spacecraft to land on the moon and explore the lunar surface then redock with the primary vessel before returning to Earth. The initial missions were Earth orbital (unmanned and manned), followed by lunar missions to orbit, and, later, land on the moon.[42]

Under the direction of the NASA's Office of Manned Space Flight, the Apollo program was the joint responsibility of the Manned Spacecraft Center in Houston, the Marshall Space Flight Center in Huntsville, and the Launch Operations Directorate at Cape Canaveral (later at Kennedy Space Center) in Florida. The Marshall Space Flight Center undertook the development of the Saturn launch vehicles. The Manned Spacecraft Center managed the development of Apollo spacecraft systems and astronaut selection and training. The Launch Operations Directorate at

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[40] Lethbridge, "Saturn I Fact Sheet"; Benson and Faherty, 43.

[41] Benson and Faherty, 37, 60-64; Barton and Levy, 30-31; Lethbridge, "Saturn I Fact Sheet"; Cleary, Eastern Range Launches.

[42] Benson and Faherty, 37, 60-64; Barton and Levy, 30-31.

Cape Canaveral (later at Kennedy Space Center), which administered launch operations, was responsible for receiving, inspecting, assembling, preflight testing, and launching of the launch vehicles and Apollo spacecraft.[43]

Following the successful test flights of the Saturn I, Block I at Launch Complex 34, NASA initiated testing of the Saturn I, Block II configuration which featured operational first and second stages. The second stage of the Block II configuration consisted of a Pratt and Whitney engine powered by a combination of liquid oxygen and liquid hydrogen. The addition of lengthened fuel tanks and improved H-1 engines increased the power of the rocket which was capable of transporting a 37,900 pound payload into Earth's orbit. When initial evaluations in late 1959 indicated that an explosion of the Block II would render Complex 34 unusable for a year, NASA initiated the construction of a second Saturn complex. Completed by January 1963, NASA conducted six test flights of the Block II configuration from Launch Complex 37 between January 1964 and July 1965.[44]

After the final test flight of the Block I configuration in March 1963, the facilities at Complex 34 were modified for the assembly, checkout, and launch of the larger, more powerful Saturn IB while NASA initiated testing of the Block II configuration at Complex 37. The USAF approved the initial modifications to the complex until it was officially transferred to NASA in November 1963. Alterations continued throughout 1964 and into 1965.[45] The more advanced vehicle configuration led to alterations and upgrades to the RP-1 and liquid oxygen fueling systems. The gaseous nitrogen and helium batteries at the High Pressure Gas Facility were subsequently replenished from the central converter-compressor facility designed to service both Launch Complexes 34 and 37. A new High Pressure Gas Battery, the Liquid Hydrogen Facility, High Pressure Gaseous Hydrogen Storage Battery and Burn Stack, an Administration Office, another Sentry House, and the Theodolite Building were installed at the complex. In addition, the Mobile Service Structure and the Umbilical Tower were modified to support the new configuration and the Apollo spacecraft.[46]

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[43] "Launch Complex 34 Facilities: Fact Sheet 05," [1].

44 Benson and Faherty, 30; Lethbridge, "Saturn I Fact Sheet"; Cleary, "45th Space Wing: Its Heritage, History & Honors 1950-2001, Launch Facilities & Programs: Complexes 34 and 37"; Clifford Lethbridge, "Cape Canaveral Rocket and Missile Box Scores," Spaceline.org, Spaceline, Inc., 2001; Clifford Lethbridge, "Cape Canaveral Launch Sites Box Scores," Spaceline.org, Spaceline, Inc., 2001.

[45] "Launch Complex 34 Facilities: Fact Sheet 05," [2].

[46] Office of Manned Space Flight, 2-9 through 2-11 and Figure 2-1; United States Air Force, Property Cards 01-21900, 21950, and 21915, Launch Complex 34 files.

The Saturn IB incorporated an uprated Saturn I first stage mated to a new second stage (Figure 6). Scientists reduced the weight of the eight Rocketdyne H-1 engines in the first stage while improving their thrust. Designed to support manned space flight, the second stage was composed of a Rocketdyne J-2 engine which burned a combination of liquid oxygen and liquid hydrogen.

Three solid-propellant ullage motors on its aft skirt provided acceleration for the spacecraft between the cutoff and separation of the first stage and the ignition of the second stage. Two auxiliary propulsion system modules also on the aft skirt provided for spacecraft maneuvering while in orbit. An Instrument Unit, which allowed for electronic control and guidance during ascent, was a ring attached to the top of the second stage. The space capsule and launch escape system utilized for the manned flights were attached to the Instrument Unit by an adaptor. Following its use in the lunar landing program, the Saturn IB was also used in Skylab and Apollo-Soyuz Test Project.[47]

The first test flight of the Saturn IB was launched from Complex 34 on February 26, 1966 (Figure 7). Two more unmanned test flights followed, one from Complex 34 and one from Complex 37. The fourth scheduled flight was to be the first manned mission scheduled to be launched from Complex 34 in February 1967. However, during a countdown simulation, three astronauts, Virgil “Gus” Grissom, Edward White, and Roger Chaffee, lost their lives in an oxygen fire in the cockpit on January 27, 1967 (Figure 8). Following an investigation of the Apollo 1 accident, the spacecraft and Umbilical Tower were altered to improve safety. The wiring, the escape hatch, the environmental control system, and the space suits were redesigned. The atmosphere in the spacecraft was changed to 60 percent oxygen and 40 percent nitrogen. Fans, water hoses, fire extinguishers, and an escape slide wire were added to the white room. In case of another fire, astronauts and workers could ride the escape slide wire to the ground in seconds.[48]

Apollo 4 in November 1967, Apollo 5 in January 1968, and Apollo 6 in April 1968 were launched as unmanned Earth orbital missions to continue testing of the Saturn rocket and the Command and Service modules; these launches took place at the new Apollo pads at Launch Complex 39.[49] Apollo activity at Launch Complex 34 continued with the October 11, 1968

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[47] Clifford J. Lethbridge, “Saturn IB Fact Sheet,” Spaceline.org, Spaceline, Inc., 1998.

[48] Benson and Faherty, 400-401; Lethbridge, “Saturn I Fact Sheet”; Lethbridge, “Cape Canaveral Rocket and Missile Box Scores”; Lethbridge, “Cape Canaveral Launch Sites Box Scores.”

[49] Lethbridge, “Saturn I Fact Sheet”; Cleary, “Complexes 34 and 37”; Lethbridge, “Cape Canaveral Rocket and Missile Box Scores”; Lethbridge, “Cape Canaveral Launch Sites Box Scores”; Barton and Levy, 31; Butowsky “Man in Space,” 5-6.

Apollo 7 launch, the first manned Apollo launch which placed astronauts into Earth's orbit for a ten-day mission (Figure 9). Essentially a test flight, the crew (Walter Schirra, Donn Eisele, and Walter Cunningham), tested the Command Service Module and its guidance and control systems, the Instrument Unit, the Spacecraft Lunar Adapter, spacesuit design, food supplies, and work routines. During the flight, the astronauts separated the Command Service Module from the second stage in order to practice rendezvous operations with the booster. Seven television transmissions from the spacecraft were broadcast on live television in the United States and overseas. Apollo 7 was the final launch from Complex 34.[50]

Continued development of the Saturn V to increase its power, necessary to propel man to the moon, led to a larger rocket with new blast and acoustic hazards. With these factors in mind, combined with the stepped-up launch schedule necessary to land a man on the moon by the end of the decade, it was apparent by 1961 that the Saturn V required a new launch complex. Cape Canaveral, with over 22 launch complexes, did not have room for another complex. NASA officials solved the dilemma by acquiring land on Merritt Island starting in 1962 to construct Launch Complex 39, west and north of the existing missile launching area at the Cape. Placed under NASA's exclusive jurisdiction, the installation was initially known as the Merritt Island Launch Area, but was renamed the John F. Kennedy Space Center in November 1963 after the death of the president.[51] The first test launch of a Saturn V occurred from the newly completed Launch Complex 39 at the Kennedy Space Center on November 9, 1967, and was designated Apollo 4. Apollo 8, the first manned launch from Complex 39, achieved the first lunar orbit in December 1968. The goal of landing man on the moon was achieved with Apollo 11 on July 20, 1969, and was followed by six additional lunar missions which gathered extensive scientific information culminating in Apollo 17 in December 1972.[52]

The success of the Saturn IB, the explosive hazards and power of the Saturn V launch vehicle, and the construction of Launch Complex 39 at Kennedy Space Center led to the termination of further Apollo development flights from Launch Complex 34. The Complex was reduced from an operationally ready state to a downmoded configuration in October 1968 and a Phaseout Plan was approved in April 1971.[53] The Complex was mothballed in November 1971, and the Service

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[50] Clifford J. Lethbridge, "Apollo 7 Fact Sheet," Spaceline.org, Spaceline, Inc., 2001.

[51] Benson and Faherty, 65-68, 96-98, 105, 133-137, 146-48.

[52] Barton and Levy, 31; Butowsky "Man in Space," 5-6; Clifford J. Lethbridge, "Saturn V (Apollo) Fact Sheet," Spaceline.org, Spaceline, Inc., 1998.

[53] "LC-34/37 Phaseout Plan," Prologue, (John F. Kennedy Space Center: National Aeronautics and Space Administration, 1971), Archives, Kennedy Space Center, LOC 31B.6, Box 2.

Structure and Umbilical Tower were razed in April 1972 due to excessive rust and deterioration. Launch Complex 34 was officially abandoned in October 1973, with most of the facilities transferred back to the USAF's control in November 1973. NASA retained control of the Operations Support Building and the Blockhouse, which served as a site for NASA tour stops until it was transferred back to the USAF in 1986.[54]

Several buildings and structures, including the Phased Array Radar Pedestal, Van Shelter, Toilet, Septic Tank, Optical Tracker, two Electrical Substations, Shop/Storage Building, and three Hazardous Waste Storage Sheds were constructed around the complex during the 1990s.[55]

Soon after Launch Complex 34 was officially abandoned, many of the structures were removed from the real property records, demolished, or moved to other complexes.[56] The Sentry Houses; Paints, Oils, Lubricants, Cleaning Fluids (POLCF) Building; Umbilical Tower; and Service Structure were demolished. The Administration Office was relocated to Launch Complex 30 in 1972. The tanks, pumps, lines, and machinery have been removed from the fueling facilities, the Amplifier Facility and Cableway, the Flume and Skimming Basin, the Theodolite Building, and the Launch Pad and Pedestal, but the concrete structures and blast walls remain to mark their locations. The Flame Deflectors remain parked in their service area. Although most of the control panels and machinery have been removed from the Blockhouse, the building remains largely intact, with the original periscopes and most of the original finishes in place (Figure 10). The interior of the Operations Support Building was extensively altered for other uses before it was demolished in 2007 or 2008.[57] Launch Complex 34 was listed as part of the National Historic Landmark District on April 16, 1984. In honor of the astronauts lost in Apollo 1 and the goals achieved at Launch Complex 34, a Historical Site Kiosk (Facility No. 21801) was erected on the Launch Pad in 1987.[58]

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[54] Master Planning, *CCAFS Basic Information Guide;* Cleary, "Launch Facilities & Programs: Complexes 34 and 37"; United States Air Force, Property Cards 01-21900 and 21934, Launch Complex 34 files; Butowsky, National Register Nomination, 7:17*.*

[55] Master Planning, *CCAFS Basic Information Guide;* United States Air Force, Property Cards 01-21900, 22003, 22004, 22005, 22006, 22007, 22008, 22010, and 26005, Launch Complex 34 files.

[56] United States Air Force, Property Cards 01-21900 and 21950, Launch Complex 34 files; United States Air Force, Voucher Nos. 75-1006 and 75-1104.

[57] Master Planning, *CCAFS Basic Information Guide.*

[58] United States Air Force, Property Cards 21801, Launch Complex 34 files.

ARCHITECTURAL DESCRIPTION OF LAUNCH COMPLEX 34

The U.S. Army Corps of Engineers initiated the construction process for Launch Complex 34 in June 1959. Construction started on the 45-acre site on June 8, 1959 (Figure 11). The complex reached "beneficial occupancy" status in February 1961 which was followed by the first launch of a Saturn missile in October. The Corps officially approved the plans and completed construction in January 1962.[59] The majority of the following physical description is based upon a review of the Real Property Cards and the *Basic Information Guides* from 1960, 1965, 1971, 1981, 1994, 2000, 2008, and 2010, as well as analysis of the As-Built Drawings completed by Maurice H. Connell & Associates, Inc. and Rader and Associates in 1959 and Pan American World Airways, Inc. in 1968.[60]

Launch Complex 34 consisted of a concrete Launch Pad and Pedestal (Facility No. 21900G, renumbered 21805) and associated structures serviced by one Blockhouse (Facility No. 21900A, renumbered 21934) and an Operations Support Building (former Facility No. 21900H). The following ancillary structures were noted in the 1960 *Basic Information Guide*: Sentry House (Facility No. 21900, renumbered 21911), High Pressure Gas Facility (Facility No. 21900B, renumbered No. 21935), LOX Facility (No. 21900C), Electric Equipment Building (Facility No. 21900D/18410B, renumbered No. 18412), RP-1 Fuel Facility (Facility No. 21900E/18410A,

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[59] Real Property Cards, Cape Canaveral Air Force Station, 45th Space Wing Office of History, Patrick AFB; "Eastern Test Range Launch Complexes, Cape Canaveral AFS," 45th Space Wing Office of History, Patrick AFB, 16 April 1991; Mark Cleary, Eastern Range Launches, (45th Space Wing Office of History, Patrick AFB, 11 December 2002); Mark Cleary, "45th Space Wing: Its Heritage, History & Honors 1950-2001, Launch Facilities & Programs: Complexes 34 and 37" (45th Space Wing Office of History, Patrick AFB, 2001); Launch Operations Center, "Launch Complex 34" (John F. Kennedy Space Center: National Aeronautics and Space Administration, [1962]), [10], Archives, Kennedy Space Center, LOC 31B.1, Box 1.

[60] United States Air Force, "Real Property Accountable Record-Inventory Detail," Property Card 01-21900, Launch Complex 34 files, Space Gateway Support Company, GIS Real Property Office, John F. Kennedy Space Center; Rader and Associates, *Air Force Missile Test Center: Complex 34.* Drawings 01-21900-003, 01-21900-004, 01-21900-005 (1959), Research Planning/Design Engineering Office, Kennedy Space Center; Maurice H. Connell & Associates, Inc. *Air Force Missile Test Center, Complex 34.* Drawings Complex 34 Launch Facilities: Location & Vicinity Maps and Index to Drawings, 01-21900-081, 01-21900-047, 01-21900-048, 01-21900-049, 01-21900-050, 01-21900-051, 01-21900-086, 01-21900-100, 01-21900-101, U-34-A1, and U-34-A2, (1959), Research Planning/Design Engineering Office, Kennedy Space Center; Pan American World Airways, Inc. *Saturn Launch Complex 34.* Drawing 34 KSC-S0-34-01 (1968) Research Planning/Design Engineering Office, Kennedy Space Center; Pan American World Airways, Inc., *Basic Information Guide, 1960*, (Cape Canaveral Missile Test Annex, 1960), Research Planning/Design Engineering and Real Property Offices, Kennedy Space Center; Pan American World Airways, Inc., *Basic Information Guide, 1981,* (Cape Canaveral Air Force Station, 1981), Research Planning/Design Engineering and Real Property Offices, Kennedy Space Center; Engineering and Environmental Planning, *CCAS Basic Information Guide: Facilities, Utilities, Instrumentation, and Communications*, (Cape Canaveral Air Station: Johnson Controls World Services, Inc., 1994); Master Planning, *CCAFS Basic Information Guide: Facilities at CCAFS and KSC.* KSC GP-14-2 (Kennedy Space Center: Space Gateway Support, October 2000).

renumbered 18411), Special Liquid Storage Building (Facility No. 18410C, renumbered No. 18413), Flume and Skimming Basin (Facility No. 21900J), Amplifier Facility and Cableway (Facility No. 21900K), and Electric Substations and Septic Tanks to serve the Blockhouse and Launch Pad (Figure 12).[61] Subsequent construction in 1962 included the Paints, Oils, Lubricants, Cleaning Fluids (POLCF) Building (former Facility No. 21900L), the Operations Support Building (former Facility No. 21900H), and a Septic Tank (Facility No. 21900M) and Electric Substation (Facility No. 21913) associated with the Operations Support Building. Although not included in the *Basic Information Guides*, the Umbilical Tower and Mobile Service Structure were vitally important facilities at the Launch Complex.[62]

Following the successful testing of the Saturn I vehicle, the USAF transferred the complex to NASA, who modified the facilities to launch the Saturn IB (Figure 13). Modifications included the construction, between 1963 and 1965, of the Liquid Hydrogen Facility (21900Q), Liquid Hydrogen Facility Electric Equipment Building (Facility No. 21900R, renumbered 18408), the High Pressure Gaseous Hydrogen Storage Battery (Facility No. 21900W) and Burn Stack (Facility No. 21900W), the High Pressure Gas Battery (Facility No.21900U), temporary trailers forming an Administration Office, and the Theodolite Building (also known as the Alignment Building; Facility No. 21915). A second Sentry House (Facility No. 21914) was moved to the complex in 1968.[63] The Launch Pad served as the hub of the complex, around which the remaining facilities were located. The Launch Pad area included the Launch Pedestal, Flame Deflector, Automatic Ground Control Station, Umbilical Tower, Mobile Service Structure, Environmental Control Systems Building, and other major firing accessories. Other elements of the complex were separated from the launching area by distances dictated by propellant explosive hazards.[64]

There was also an area separate from and north of the main launch complex that contained support facilities such as a theodolite tower, a substation, camera sites, a maintenance supervisor's office, paint storage buildings, and a spray paint shed. These facilities were mostly constructed between 1960 and 1965, and the majority remained until Complex 34 was

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[61] Pan American World Airways, Inc., *Basic Information Guide, 1960*.

[62] United States Air Force, Property Card 01-21900, Launch Complex 34 files.

[63] United States Air Force, Property Card 01-21900, Launch Complex 34 files.

[64] "LC 34-37 Launch Complexes and Ground Support Equipment," (John F. Kennedy Space Center: National Aeronautics and Space Administration, [1961]), 1-2, Archives, Kennedy Space Center, LOC 31B.5, Box 1.

abandoned. By 1975, everything was removed except for a small storage building which had been abandoned in 1971. It was removed by 1993.[65]

LAUNCH PAD AREA

Launch Pad and Pedestal (Facility No. 21805)

The Launch Pad and Pedestal (Facility No. 21805) is located approximately 1,000' northeast of the Blockhouse. Constructed of reinforced concrete, the circular Launch Pad is 430'-0" in diameter with a maximum height of 16'-0" above sea level, set on soil consolidated by vibroflotation. The Pedestal, located in the center of the Launch Pad, was used to support the launch vehicle during checkout and firing. The 42'-0" square, 27'-0" high Pedestal is constructed of reinforced concrete formed over steel stiffeners supported on four columns (Figure 14). The platform and leg surfaces exposed to vehicle exhausts were plated with steel. The structure is set on a foundation containing approximately 13½ million pounds of reinforced concrete set 106'-0" by 160'-0" and poured 4'-0" thick at the outer edges and 8'-0" thick at the center. A 25'-0" diameter opening in the center of the platform provided access to the vehicle boattail section. During a launch, the opening in the platform of the Pedestal allowed the engine exhaust to pass through to the Flame Deflector which was situated beneath the opening between the columns of the Pedestal. The portion of the pad around the deflector is surfaced with refractory brick to protect the pad from the rocket exhaust.[66]

Eight steel vehicle support arms mounted on the platform of the Pedestal provided support to the erected vehicle (Figure 15). Four of the supports, situated 90 degrees apart, were cantilevered

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[65] Pan American World Airways, Inc., *Basic Information Guide, 1960*, (Cape Canaveral Missile Test Annex, 1960); Pan American World Airways*, Cape Kennedy Air Force Station: Building Schedules and Locations* (Patrick Air Force Base, FL: Facilities Planning Section, 1965); Pan American World Airways, Inc., *Basic Information Guide, Cape Canaveral: Facilities, Utilities, Instrumentation, and Communications*, 1965, (Cape Canaveral Air Force Station: Facilities Engineering Department 1965); Engineering and Environmental Planning, *CCAS Basic Information Guide: Facilities, Utilities, Instrumentation, and Communications*, (Cape Canaveral Air Station: Johnson Controls World Services, Inc., 1993).

[66] Launch Operations Center, [5-6]; "LC 34-37 Launch Complexes and Ground Support Equipment," 2; "Launch Complex 34 Facilities: Fact Sheet 05," (John F. Kennedy Space Center: National Aeronautics and Space Administration, 1966), [2, 7], Archives, Kennedy Space Center, LOC 31B.1, Box 1; Office of Manned Space Flight, "Apollo Systems Description, Volume III," (Launch Operations Center: National Aeronautics and Space Administration, 1963), 2-2, Archives, Kennedy Space Center, LOC 31C.1, Box 1; Maurice H. Connell & Associates, Inc., Drawings 01-21900-086, 01-21900-100, and 01-21900-101; Charles D. Benson and William B. Faherty, Moonport: A History of Apollo Launch Facilities and Operations (National Aeronautics and Space Administration, Scientific and Technical Information Office, 1978; reprint as *Gateway to the Moon: Building the Kennedy Space Center Launch Complex and Moon Launch! A History of the Saturn-Apollo Launch Operations*, Gainesville: University Press of Florida, 2001), 29 (page references are to reprint edition).

toward the vehicle at the outboard engine positions. In order for the engine shrouds to clear the arms at liftoff, these four arms would retract horizontally after the thrust commit signal was given. Located alternately between these support arms, the other four support arms also served as holddown points during thrust buildup following the ignition command signal. These holddown arms were released by a toggle linkage activated at the launch commit signal. If any of the retractable support arms failed to operate or in case of an emergency cutoff prior to release, all four retractable supports automatically returned to their locked position. Although the complex was mothballed in 1971 and transferred from NASA back to the USAF in 1973, the Launch Pad and Pedestal remain in place.[67]

Flame Deflectors

Situated between the columns of the Pedestal during a launch, the Flame Deflector was used during a launch to protect the launch pad and launch pedestal by deflecting the 5000º Fahrenheit engine flame into two controlled directions. The Flame Deflector was built with a series of roof-type trusses formed in an inverted V at an 80 degree angle. Constructed of welded and bolted steel, the two flame-deflecting surfaces are covered with 1" steel plates coated with a 4" layer of special heat-resistant ceramic. Overall, the 150-ton Deflector is approximately 43' long, 32' wide, and 21' high. Shipped to the complex in sections, the Flame Deflector was assembled on the supporting rail system. When in position under the Pedestal, the four retractable railway wheels were raised hydraulically and the load was transferred to tiedown anchor points. Shear plates were lowered into slots to prevent the Deflector from moving. Hinged 41"-high side shields protected against flame spillage and backwash over the sides of the Deflector. When not in use, the Flame Deflector was moved along the track to its parking and repair area at the northwest edge of the launch pad. A second Flame Deflector was available on the spur track in case of major damage to a Deflector during launch. To further protect the launch pad, the central portion of the pad in the vicinity of the Flame Deflector is paved with refractory brick to protect it from the intense heat during a launch.[68]

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[67] Launch Operations Center, [5-6]; "LC 34-37 Launch Complexes and Ground Support Equipment," 3; "Launch Complex 34 Facilities: Fact Sheet 05," [2]; United States Air Force, "Real Property Voucher," Voucher No. 75-1104, Space Gateway Support Company, GIS Real Property Office, John F. Kennedy Space Center; Maurice H. Connell & Associates, Inc., Drawings 01-21900-086, 01-21900-100, and 01-21900-101.

[68] Launch Operations Center, [6]; "LC 34-37 Launch Complexes and Ground Support Equipment," 2-4; Office of Manned Space Flight, 2-3; "Launch Complex 34 Facilities: Fact Sheet 05," [2].

Automatic Ground Control Station

Serving as a distribution point for all of the measuring and checkout equipment, power, and high-pressure gas, the Automatic Ground Control Station provided 8,170 square feet of usable space under the Launch Pad. This facility consisted of an electronic equipment room, battery room, distributor pit, generator room, terminal room, and a restroom. Access was provided to these rooms by a flight of stairs at the northern edge of the Pad, adjacent to the Flame Deflector parking and repair area. All of the sub-pad rooms, which constituted the Automatic Ground Control Station, are linked and held terminal boards, instrumentation racks, and high-pressure gas lines, in addition to the mechanical and electrical equipment. Electrical, communications, and control cables and lines extended from the terminal room near the center of the Pad through an access tunnel and an above-ground roofed cableway to the Blockhouse. Ventilation was incorporated into the design, and motor-driven sump pumps provided drainage.[69]

Environmental Control Systems (E.C.S.) Building

The E.C.S. Building was constructed for the Saturn 1B launch vehicle configuration. Prior to this, the E.C.S. equipment was housed on an open-air concrete platform with a 14'-high deck supported by columns that also held equipment and supported cable trays connecting to the adjacent umbilical tower. The new enclosed building was constructed to the north of the existing E.C.S. platform, on a concrete slab, and had concrete-block walls covered with a smooth concrete coat. It housed Heating, Ventilation, and Air Conditioning (HVAC) systems to provide conditioned air through the umbilical tower to the launch vehicle and spacecraft (if included on the vehicle). The old platform and deck were roofed over, continuous with the new building's open-air second story addition (Figure 16). There are/were sleeve openings on both the north and south walls for conduit to pass through. Equipment in the building included air conditioning units, an air compressor, a demineralizer, and a second floor expansion tank. The north wall of the enclosed building remains in place, along with low curbs outlining the remaining walls.

An operational intercom system, with approximately 300 stations, was installed throughout the complex. A closed-circuit television loop, consisting of 20 television monitors and 11 cameras, was also used for monitoring, checkout, and observing a launch. Cameras, remotely controlled

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[69] Launch Operations Center, [6]; "LC 34-37 Launch Complexes and Ground Support Equipment," 5; Office of Manned Space Flight, 2-4; Maurice H. Connell & Associates, Inc., Drawing 01-21900-100.

from the Blockhouse, were mounted around the Launch Pedestal for photographic coverage of launch operations.[70]

Water Deluge System

A quenching system was installed to reduce the intense heat and remove spilled fuel from the Launch Pedestal area. As part of the Water Deluge System, a 36" water line extended water to the torus ring of the Pedestal. Four 3,500 gallon-per-minute nozzles were installed at the Pad surrounding the launch vehicle as a general protection measure. The Water Deluge System provided a water shield between the engines of the Saturn vehicle and the burning propellant residues in case of an emergency cutoff of the engines prior to launch. Additionally, water was available at the Launch Pad and at all work levels of the Umbilical Tower and Service Structure.[71]

Flume and Skimming Basin (Facility No. 21900J)

The Launch Pad was graded with a perimeter trench connected to a skimming basin for the drainage of surface water and possible propellant spillage. The Flume and Skimming Basin (Facility No. 21900J), constructed in 1961, collected excess water and fluids spilled on the Launch Pad in order to prevent contamination of the surrounding ground. The Flume is essentially a concrete-lined ditch which extends from under the Launch Pad northeast approximately 300' to the Skimming Basin, which is situated outside of the perimeter road. The Skimming Basin is a concrete paved vat approximately 104' x 180'. Collected RP-1 fuel, which floated on the surface of the water, could be burned in the Skimming Basin. After NASA returned the complex to the USAF in 1973, this facility was abandoned in place in August 1974. The Flume and Skimming Basin remain on site. [72]

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[70] Launch Operations Center, [10]; Office of Manned Space Flight, 2-8; United States Air Force, Property Card 01-21900, Launch Complex 34 files.

[71] Launch Operations Center, [10]; “LC 34-37 Launch Complexes and Ground Support Equipment,” 3; Benson and Faherty, *Moonport*, 21.

[72] Launch Operations Center, [9]; “LC 34-37 Launch Complexes and Ground Support Equipment,” 2; United States Air Force, Property Card 01-21900, Launch Complex 34 files; United States Air Force, Voucher No. 75-1006.

Umbilical Tower

Although not individually noted in the *Basic Information Guides*, an Umbilical Tower was also part of the complex. The Umbilical Tower provided various electrical cables, pneumatic lines, checkout consoles, cryogenic replenishing lines, liquid nitrogen cooling tanks, mechanical refrigeration units, air-conditioning ducts, valve complexes, and other systems necessary to service the booster and upper stages. Situated adjacent to the Launch Pedestal, the Umbilical Tower was an open truss steel structure 24'-0" square at its base and 240'-0" high including the base. The base was enclosed by steel blowout panels which provided two air-conditioned equipment rooms to house preflight checkout equipment, tower electrical distribution system, and other equipment. From the 27'-0" level (above the 24'-0" square base building), the tower tapered to 10'-7½" square at the top (Figure 16).[73]

A one-ton capacity elevator provided access between the service platforms located at each 20'-0" level above the base. A 5,000-pound capacity electric hoist, which incorporated a 27'-0" hook reach and a 360-degree pivot, was mounted on top of the tower to lift electrical cables, umbilical arms, and other heavy equipment. Four hydraulically-controlled umbilical swing arms, weighing approximately one ton each, were attached to the tower by hinged joints at the nearest diagonal leg of the tower, and extended horizontally toward the vehicle. Each arm was capable of swinging 135 degrees to either side and could be adjusted vertically in 6" increments. Each arm held links between the vehicle and the tower which led to the ground-based power, air conditioning, hydraulic, pneumatic, fuel, measuring, and command systems. Situated at the 220'-0" level, the Apollo spacecraft access arm provided a means for astronauts to enter or leave the spacecraft. This arm was connected to the "white room," an environmentally sterile room located in the Umbilical Tower. The elevator, which could travel at a speed of 450' per minute, provided a means of egress in an emergency. The Umbilical Tower was razed in April 1972 due to excessive rust and deterioration.[74]

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[73] "LC 34-37 Launch Complexes and Ground Support Equipment," 4; Office of Manned Space Flight, 2-3 through 2-4; Maurice H. Connell & Associates, Inc., Drawings U-34-A1 and U-34-A2; Master Planning, *CCAFS Basic Information Guide*.

[74] "LC 34-37 Launch Complexes and Ground Support Equipment," 5; "Launch Complex 34 Facilities: Fact Sheet 05," [3]; Office of Manned Space Flight, 2-3 through 2-4; Cleary, "Launch Facilities & Programs: Complexes 34 and 37"; United States Air Force, Property Card 01-21900, Launch Complex 34 files; Harry Butowsky, National Register of Historic Places Nomination Form/National Historic Landmark Federal Agency Nomination: Cape Canaveral Air Force Station (Washington, D.C.: National Park Service, 1983), 7:17.

Mobile Service Structure

Similarly, the Mobile Service Structure was also part of the complex, although it was not individually noted in the *Basic Information Guides*. The Mobile Service Structure, which provided work platforms for the assembly, checkout, and servicing of the launch vehicle, was an inverted U-shaped, rigid box truss frame design (Figure 17). The structure rose 310'-0" in height, extended 130'-0" x 70'-0" at the base, and weighed 2,900 tons. The central top box truss, with its bridge runway hoisting equipment, was 130'-0" long, 70'-0" wide, and 50'-0" deep. The bridge crane, with vertically adjustable runway trusses, had individually controlled 40- and 60-ton hoists with a 245'-0" hook height which could be extended to 281'-0". Two smaller hoists were located at the 310'-0" level. The top box truss rested on two box truss columns with 37'-0" x 70'-0" cross sections, each of which rested on a two-story base section 37'-0" wide x 70'-0" long. Each leg of the structure incorporated a two-story building containing operation and checkout equipment, a work deck, seven fixed platforms with 790 square feet of floor area each, and eight movable, enclosed, horizontally-retracting platforms with 814 square feet of floor space used to encase the vehicle in a 56'-0" wide central opening. Each platform was designed to support a capacity of 12 personnel and 600 pounds of equipment. Two personnel and one freight elevator provided access to the platforms. The two 25'-0" high base sections held engineering and laboratory space and power equipment necessary for self-locomotion of the tower on a dual-track railway system between the Mobile Service Structure Parking Area and the Launch Pad.[75]

Anchored to steel piers by hydraulically operated steel pins, the Service Structure and encased launch vehicle could withstand hurricane force winds of 125 miles per hour. Four hurricane doors, which extended from the Launch Pedestal to the 80'-0" level, and two retractable silo sections, which extended from the 80'-0" to the 224'-0" levels, protected the space vehicle from adverse weather conditions. Mounted on four 12-wheel trucks, each powered by 100-horsepower electric motors, the structure was moved between 1'6" to 40'-0" per minute by an operator situated in a cab at the 27'-0" level. At the Launch Pedestal, support points moved the Service Structure from the tracks and anchored it to the ground. After checkout was complete, the Service Structure was moved on two sets of tracks placed 90'-0" apart to its parking area, approximately 600' southwest of the Launch Pedestal. Automatic synchronizing controls

[75] Maurice H. Connell & Associates, Inc., Drawings 01-21900-047, 01-21900-048, 01-21900-049, 01-21900-050, and 01-21900-051; Pan American World Airways, Inc., Drawing 34 KSC-S0-34-01; Office of Manned Space Flight, 2-5; Launch Operations Center, [4-5]; "LC 34-37 Launch Complexes and Ground Support Equipment," 7-8; *Technical Facilities Catalog: Volume II*, (Washington, D.C.: National Aeronautics and Space Administration, 1967), 10-10, Archives, Kennedy Space Center, NHB 8800.5(I), LOC 23A.2N; "Launch Complex 34 Facilities: Fact Sheet 05," [6].

prevented skewing the tower during movement. A self-contained, 500 kV-a diesel-electric generator powered the motors and tower equipment during movement. External ground power was used for all operations except tower locomotion and emergency lighting. The tower had lightning protection and grounding systems, aircraft warning lights, and illumination for night operations. The Service Structure was razed in April 1972 due to excessive rust and deterioration.[76]

Theodolite Building (Facility No. 21915) and Amplifier Facility and Cableway (Facility No. 21900K)

The Theodolite Building (Facility No. 21915), also known as the Alignment Building, was constructed by NASA in 1965 as part of the improvements for the Saturn IB. Located immediately south of the Launch Pad, the facility held a theodolite utilized in maintaining the azimuth alignment. With 287 square feet of space, the concrete building has a concrete foundation and concrete roof. After the transfer back to the USAF in 1973, the building was abandoned in 1975.[77]

The Amplifier Facility and Cableway (Facility No. 21900K) was constructed in 1960 as one of the original facilities at the complex. The Cableway consisted of an above-ground roofed linear structure extending from the Blockhouse to the southern perimeter of the Launch Pad, where it moved underground into the Automatic Ground Control Station. Poured concrete stanchions supported the cable trays. The Amplifier Facility is a concrete block structure that incorporates 400 square feet of space and is set on a concrete foundation with a built-up roof. There was a single door opening. The Amplifier Facility and Cableway held all of the lines of power and communications between the Launch Pad and the Blockhouse. The Amplifier Facility housed equipment that boosted the signals on their way from the Pad to the Blockhouse. After the transfer back to the USAF in 1973, the facility was abandoned in 1975. The Amplifier Facility

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[76] Maurice H. Connell & Associates, Inc., Drawings 01-21900-047, 01-21900-048, 01-21900-049, 01-21900-050, and 01-21900-051; Pan American World Airways, Inc., Drawing 34 KSC-S0-34-01; Butowsky, National Register Nomination, 7:17; Launch Operations Center, [4-5]; "LC 34-37 Launch Complexes and Ground Support Equipment," 7-8; Office of Manned Space Flight 2-5; "Launch Complex 34 Facilities: Fact Sheet 05," [6]; Cleary, "Launch Facilities & Programs: Complexes 34 and 37"; United States Air Force, Property Card 01-21900, Launch Complex 34 files.

[77] United States Air Force, Property Cards 01-21900 and 21915, Launch Complex 34 files; Pan American World Airways, Inc., *Basic Information Guide, 1981;* United States Air Force, Voucher No. 75-1104; ; Al Hartmann, Volunteer, Air Force Space and Missile Museum, E-mail, 16 June and 26 June 2003, CCAFS, Archaeological Consultants, Inc., Sarasota.

and the Cableway remain in place, although the Cableway is no longer roofed, and the cables and cable trays have been removed.[78]

PROPELLANT STORAGE AND TRANSFER SYSTEMS

Liquid Oxygen (LOX) Facility (No. 21900C)

The Liquid Oxygen (LOX) Facility (No. 21900C) is situated approximately 650’ south of the Launch Pad and Pedestal. Stored and transferred at -297º Fahrenheit, LOX was utilized to fuel the first and second stages of the launch vehicle. This fuel storage area, which consisted of a LOX tank and a replenishing tank, was situated on a concrete slab foundation (Figure 18). A reinforced concrete blast wall, with earthen fill on the north side, borders this fuel storage area on the north to separate the fuel from the Launch Pad and Pedestal. The 125,000 gallon capacity main fill tank was an insulated sphere with an outside diameter of 41'-3". An inner sphere, which actually contained the LOX, was separated from the outer sphere by 4'-0" of expanded perlite, a mineral insulating powder, in a pressurized gaseous nitrogen atmosphere. Utilizing a heat exchanger, a working air pressure of 30 pounds per square inch gage (psig) was maintained for self-pressurization. A 350 horsepower motor powered a 2,500 gallon-per-minute, 400' head pressure cryogenic pump to transfer LOX through an 8" line from the spherical tank to the vehicle booster during main fill operations. When live upper stages were involved, a 175 horsepower electric motor powered a 1,000 gallon-per-minute, 500' head pressure cryogenic pump to transfer LOX through a 6" line in a fuel trench to the umbilical tower line. From here, individual lines led to the stage servicing connections during the main fill operations.[79]

A smaller 13,000 gallon, 11' diameter cylindrical LOX tank was used to replenish the oxygen which evaporated during the latter stages of launch preparation. Vacuum-jacketed, perlite insulation insured low evaporation loss. The tank was self-pressurized to 200 psig working air pressure. The booster and upper stages were replenished through a 3" vacuum-jacketed line from the replenishing LOX tank to the umbilical tower line. The liquid level in the booster LOX tanks was maintained with a pneumatically actuated modulating valve controlled by a LOX tanking computer and level control system. The LOX transfer system was completely automated and

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[78] United States Air Force, Property Cards 01-21900 and 21915, Launch Complex 34 files; Pan American World Airways, Inc., *Basic Information Guide, 1981;* United States Air Force, Voucher No. 75-1104.

[79] Launch Operations Center, [8]; “LC 34-37 Launch Complexes and Ground Support Equipment,” 2-8; Office of Manned Space Flight, 2-7; “Launch Complex 34 Facilities: Fact Sheet 05,” [4-5]; Maurice H. Connell & Associates, Inc., Drawings 01-21900-086 and 01-21900-100.

remotely controlled from panels in the Blockhouse. Prior to propellant loading, the system component checkout was accomplished from either the Blockhouse or the LOX facility.[80]

RP-1 Fuel Facility/Industrial Waste Storage Facility (Facility No. 18411), Electric Equipment Building (Facility No. 18412), and the Special Liquid Storage Building (Facility No. 18413)

Approximately 950’ southeast of the Launch Pad and Pedestal, the RP-1 Fueling Facility, later known as the Industrial Waste Storage Facility (Facility No. 18411), was used to store and transfer this kerosene-based fuel utilized in the launch vehicle’s first stage. Consisting of storage and transfer equipment set on a concrete slab, RP-1 and its storage facility is separated from the launch area by a reinforced concrete blast wall and protective revetment which creates approximately 4,378 square feet of space. Two 11'-0" diameter, 30,000 gallon insulated cylindrical tanks were used for fuel storage. The transfer system and associated plumbing consisted of two 1,000 gallon-per-minute centrifugal pumps operating at 175 psig head pressure, a circulation pump, filter-separator unit, an eductor system, and miscellaneous valves, piping, and controls. The booster was serviced by the two 1,000 gallons-per-minute pumps manifolded into an 8” transfer line set in a fuel trench. A fuel density indicator was used to monitor the RP-1 fuel density at all times. The fuel tank of the vehicle was initially overfilled. The excess was drained by a tanking computer which would adjust the fuel level to 100 percent. When all of the vehicle’s tanks were filled to the correct level, the jet eductor evacuated the transfer lines. Prior to liftoff, the correct LOX fuel weight ratio was maintained by replenishing the LOX to the level dictated by the fuel level and density. The transfer system was completely automated and controlled from the Blockhouse. Prior to loading the vehicle with fuel, a system component checkout was automatically performed.[81]

The RP-1 Fueling Facility and its support buildings, the Electric Equipment Building (Facility No. 18412) and the Special Liquid Storage Building (Facility No. 18413), were constructed in 1960 as part of the original facilities of the complex. The Electric Equipment Building powered the RP-1 Fueling Facility. This small concrete building, with 216 square feet of space, is constructed on a concrete foundation topped by a built-up roof. The Special Liquid Storage

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[80] Launch Operations Center, [8]; “LC 34-37 Launch Complexes and Ground Support Equipment,” 2-9; Office of Manned Space Flight, 2-7; “Launch Complex 34 Facilities: Fact Sheet 05,” [4-5]; Master Planning, *CCAFS Basic Information Guide*.

[81] Launch Operations Center, [8]; “LC 34-37 Launch Complexes and Ground Support Equipment,” 2-10; “Launch Complex 34 Facilities: Fact Sheet 05,” [3]; United States Air Force, Property Cards 01-21900 and 21900E, Launch Complex 34 files; Maurice H. Connell and Associates, Inc., Drawings 01-21900-086 and 01-21900-100.

Building also served as part of the RP-1 Fueling Facility. With 252 square feet of space, the concrete building has a concrete foundation and a built-up roof. Along with the rest of Complex 34, the RP-1 Fueling Facility, the Electric Equipment Building, and Special Liquid Storage Building were transferred to NASA in 1963. NASA returned the three facilities to the USAF in 2000.[82] All three remain on site.

Liquid Hydrogen (LH$_2$) Facility (No.21900Q), Electrical Equipment Building (Facility No. 18408), and the High-Pressure Gaseous Hydrogen (GH$_2$) Storage Battery (Facility No. 21900W)

Utilized for servicing the hydrogen-fueled upper stages of the Saturn IB, the highly flammable Liquid Hydrogen (LH$_2$) Facility (No.21900Q), is situated approximately 830' northeast of the Launch Pad, outside the perimeter road. It was constructed between 1963 and 1965 for the Saturn IB configuration. A reinforced concrete blast wall and protective revetment separates the fueling facility from the launch area and provided partial weather protection. Liquid hydrogen was stored and transferred at -423º Fahrenheit. The facility consisted of a spherical tank, pneumatic and electrical consoles, and necessary plumbing and valves. The stainless steel, 38' diameter, insulated and vacuum-jacketed spherical storage tank had a capacity of 125,000 gallons. A vacuum pump was provided for use in the storage tank purging and inerting sequence, which was required prior to the initial filling. The LH$_2$ tank was filled and replenished by pressure transfer through a 5" vacuum-jacketed line set in a fuel trench. A 100 psig tank working pressure was maintained for transfer operations. The system had the capability to deliver 3,000 gallons per minute with a replenish rate of 0 to 200 gallons per minute, and a fine-fill rate of 500 gallons per minute. Because LH$_2$ is highly explosive, all of the electric starters and distributors for the facility were located in nitrogen-purged panels in a building removed from the storage tank. Special ducting systems on the vehicle and umbilical tower disposed of the gaseous hydrogen resulting from the vehicle tank cooldown operations and venting of the loaded tank. These ducting systems removed the hydrogen to the LH$_2$ Burn Pond situated northwest of the LH$_2$ storage area. The transfer system was completely automated and remotely controlled from the Blockhouse. An Electrical Equipment Building (Facility No. 18408) provided power to the

[82] United States Air Force, Property Cards 01-21900, 21900E, 21900D, 18410A, 18410B, 18410C, 18411, 18412, and 18413, Launch Complex 34 files.

facility. With 240 square feet of space, the concrete building has a concrete foundation and a built-up roof.[83]

The High Pressure Gaseous Hydrogen (GH_2) Storage Battery (Facility No. 21900W) is located immediately southwest, between the LH_2 Facility and the perimeter road. Constructed in 1965, this facility supplied cold hydrogen gas for launch vehicle pneumatic requirements. The facility consisted of two 200 cubic foot cylindrical gaseous hydrogen vessels capable of delivering a maximum pressure of 6,000 pounds per square inch (psi). The tanks sat on a concrete slab and were surrounded on three sides by concrete walls. After NASA returned the complex to the USAF in 1973, these facilities were retired in 1975.[84] The blast wall, concrete partial walls, and Facility No. 18408 remain in place.

High Pressure Gas Facility (Facility No. 21935) and High Pressure Gas Battery (Facility No. 21900U)

The original High Pressure Gas Facility (No. 21935) was constructed in 1960, east of the Blockhouse and south of the Launch Pad and Pedestal. The High Pressure Gas System converted, stored, and transferred gaseous nitrogen and helium to the vehicle and various functional stations during prelaunch operations. The system provided high pressure gas for vehicle checkout, purging and pressurization, for functional operation of certain ground support equipment, and for charging the vehicle storage spheres which supply the in-flight requirements. Gaseous nitrogen was used to charge the vehicle storage spheres for in-flight consumption, to operate ground service equipment components, and as a purging agent. Helium was used for first stage pressurization, for upper-stage in-flight storage spheres, and for liquid oxygen tank bubbling to prevent temperature stratification prior to launch. This facility consists of a 53'-0" x 31'-0" x 18'-0" high concrete revetted, vault-type structure with 2,332 square feet of space, which was used to store cylinders (batteries) of high-pressure helium and nitrogen gases. The facility incorporated storage and transfer facilities, filters, control panels, and measuring devices. The

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[83] Launch Operations Center, [9]; "LC 34-37 Launch Complexes and Ground Support Equipment," 2-11; "Launch Complex 34 Facilities: Fact Sheet 05," [3-4]; United States Air Force, Property Card 01-21900, Launch Complex 34 files; Pan American World Airways, Inc., *Basic Information Guide, 1981;* Maurice H. Connell & Associates, Inc., Drawing 01-21900-100.

[84] "Launch Complex 34 Facilities: Fact Sheet 05," [5]; United States Air Force, Property Card 01-21900, Launch Complex 34 files; United States Air Force, Voucher Nos. 75-1104.

measuring devices were for the control of contamination, moisture, and hydrocarbon content of the stored gases. The storage system consisted of a cluster of 6,000 psig storage cylinders.[85]

Nitrogen and helium were supplied and stored in two mobile transfer/converter vehicles which connected to the fixed, high-pressure storage battery facility. Nitrogen, procured in liquid form and converted to gas, was utilized to purge fuel and LOX lines, engine and instrument compartments, and to operate certain pneumatic components. The liquid nitrogen was converted to a high-pressure gas at 6,000 psig through the use of electrical heaters and ethylene glycol/liquid nitrogen heat exchangers integral with the transfer vehicle. Four stainless-steel lines transferred the gaseous nitrogen to a primary distributor station in the mechanical room of the Automatic Ground Control Station at the launch pad. Once at the pad, the pressure of the gas was reduced to 3,000 psig for further distribution to the using points. A pressure-reducing valve complex at the storage site supplied nitrogen at 3,000 psig to the LOX and fuel storage areas.[86]

Helium, procured at 3,000 psi pressure, was compressed and stored in a pressure battery at 6,000 psi. Used for bubbling the LOX tanks of the booster and to prevent the LOX from forming strata of different temperatures, the gaseous helium was delivered to the storage site at 2,200 psig pressure in mobile transfer/converter vehicles which were connected to the fixed, high-pressure storage battery facility. Two trailer-mounted, motor driven helium booster compressors with 70 standard cubic feet per minute (scfm) capacity located within the storage structure raised the pressure to 6,000 psig, after which it was stored in bottles. Helium at 6,000 psig was delivered to the primary pneumatic distributor in the mechanical room of the Automated Ground Control Station to the base of the Launch Pedestal.[87]

Alterations to the complex in 1963 for the Saturn IB configuration included the elimination of the mobile storage and vaporizer vehicles. The batteries were subsequently replenished from the central converter-compressor facility designed to service both Launch Complexes 34 and 37. A new High Pressure Gas Battery (Facility No. 21900U) was constructed east of the Launch Pad to

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[85] Launch Operations Center, [9]; "LC 34-37 Launch Complexes and Ground Support Equipment," 2-12; Office of Manned Space Flight, 2-7 thorough 2-9, Figure 2-1; United States Air Force, Property Cards 01-21900 and 21900B, Launch Complex 34 files.

[86] Launch Operations Center, [9]; "LC 34-37 Launch Complexes and Ground Support Equipment," 2-12; Office of Manned Space Flight, 2-7 through 2-9, Figure 2-1.

[87] Launch Operations Center, [9]; "LC 34-37 Launch Complexes and Ground Support Equipment," 2-12; Office of Manned Space Flight, 2-7 thorough 2-9, Figure 2-1.

provide additional storage space closer to the Launch Pad for the expanded number of high-pressure nitrogen and helium storage batteries necessary for the new vehicle.[88]

By 1966, storage for liquid nitrogen was provided by a 125,000 gallon, double-walled, spherical tank and a 35,000 gallon tank. Liquid nitrogen was converted to gaseous nitrogen through the use of four high-pressure vaporizers and two low-pressure vaporizers. It was then transferred to gaseous nitrogen storage batteries. Four 200 cubic foot vessels and six clusters of nine vessels each (200 cubic feet per cluster) were manifolded together to form the nitrogen battery. Helium was compressed by means of three separate, four-stage compressors and was stored in the helium storage battery which consisted of six clusters of nine vessels each (200 cubic feet per cluster) manifolded together. The High Pressure Gas Facility and the High Pressure Gas Battery were abandoned in place in 1973.[89] The High Pressure Gas Facility remains on site, and has been categorized as a storage facility since 2005. The main concrete wall of the High Pressure Gas Battery also remains in place.

BLOCKHOUSE AND TECHNICAL SUPPORT AREA

Blockhouse (Facility No. 21934), Electrical Substation (Facility No. 21912), and Septic Tank (Facility No. 21916)

Situated approximately 1,000' southwest of the Launch Pad, the domed Blockhouse (Facility No. 21934) was constructed in 1960 and operated as the launch control center housing the communications, instrumentation, and control consoles. The interior of the 120'-diameter dome features 20,396 square feet of floor space on two floors (Figure 19). For the construction of the Blockhouse in 1959, a large area was excavated and partially filled with sand onto which the reinforced concrete foundation was poured (Figure 20). The 12-sided, dome-shaped portion of the building consists of three different layers. The inner dome is constructed of reinforced concrete, poured approximately 5' thick, and covered by sand varying in thickness from 7'-0" at the apex of the dome to 30'-0" at the base. The earthen fill is covered with a 4"-thick layer of shotcrete. The interior of the dome is sprayed with a 2" coat of acoustical material. A special blastproof door weighing 23 tons further insulates the structure to withstand blast pressure of

[88] Office of Manned Space Flight, 2-7 through 2-9, and Figure 2-1.

[89] "Launch Complex 34 Facilities: Fact Sheet 05," [5]; United States Air Force, Property Cards 01-21900, 21935, and 21900B, Launch Complex 34 files; United States Air Force, Voucher Nos. 75-1104.

2,188 psi equivalent to the explosion of 50 kilotons of TNT at a distance of 50', necessary should a missile explode on the pad or near the launch site.[90]

These insulating layers provide the Blockhouse with an interior diameter of 80' and a maximum height of 26'. The first floor was utilized by booster and upper stage contractor personnel who were involved in closed-circuit television and tracking, telemetry, and communications operations. The first floor held two Instrument Rooms, an RF and Telemetry Room, a Terminal Room, a Range Terminal and Utility Area, a Ready Room, and a Toilet Room. The entrance to the Blockhouse is inset through a flat-roofed extension on the west side of the building. In addition to the inset entrance, this extension held an Equipment Room and Toilet Room and was subsequently enlarged in 1966. Communication and power lines linking the Blockhouse to the other facilities at the complex entered the building through the Cableway which met the building on the northeast corner. The lines stretched from the Cableway through an underground trench to an Instrumentation Pit at the east end of the Blockhouse, and extended throughout the Blockhouse through Instrumentation Trenches beneath the floor. With the exception of the restrooms which have ceramic tile floors, the remaining rooms on the first floor have steel trowel floors, gypsum board and exposed concrete walls, and ceilings with exposed steel. Emergency escape tunnels are located in the northwest and southwest corners. An equipment elevator and stairs to the second floor are located in the northwest corner of the building.[91]

The second floor held launch supervision and monitoring and recording panels (Figure 21). The majority of the second floor was occupied by the Instrument Room, also known as the Control Room. A small Observation Room was separated by glass from the operating area. An observation balcony on top of the building provided an aerial view during pre-launch activities. These two rooms have asphalt tile floors, a ceiling covered with acoustical spray-on material, and walls with a rubber base topped by exposed concrete. Two periscopes in the control room and an eight-station, closed-circuit television network provided views of the launch. These periscopes and most of the interior finishes remain intact.[92] An Electrical Substation and a Septic Tank with a capacity of 1,000 gallons served the Blockhouse. The transformers have been

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[90] "Launch Complex 34 Facilities: Fact Sheet 05," [7]; *Technical Facilities Catalog: Volume II*, 10-9; Office of Manned Space Flight, 2-5 through 2-6; Master Planning, *CCAFS Basic Information Guide*; Rader and Associates, Drawings 01-21900-003, 01-21900-004, and 01-21900-005; Launch Operations Center, [3].

[91] "Launch Complex 34 Facilities: Fact Sheet 05," [7]; Launch Operations Center, [4]; Office of Manned Space Flight, 2-5 through 2-6; Rader and Associates, Drawing 01-21900-003.

[92] "Launch Complex 34 Facilities: Fact Sheet 05," [7]; Launch Operations Center, [4]; Office of Manned Space Flight, 2-5 through 2-6; "LC 34-37 Launch Complexes and Ground Support Equipment," 6; Rader and Associates, Drawings 01-21900-003, 01-21900-004, and 01-21900-005.

removed from the Electrical Substation.[93] Along with the rest of the complex, the Blockhouse was transferred from the USAF to NASA in 1963. In 1986, NASA returned the Blockhouse to the USAF. The Blockhouse is currently used for storage.[94]

Operations Support Building/Engineering Support Building (former Facility No. 21900H)

Situated southwest of the Blockhouse, the Operations Support Building (former Facility No. 21900H) had 30,506 square feet of space and was constructed in 1962. The one-story building provided laboratory facilities for measurement and calibration of telemetry and ground support equipment, network checkout, missile component checkout and evaluation, and prelaunch test and post-launch data review and evaluation. Utilized for general shop and engineering activities in direct support of launch operations, the building also provided space for critical parts storage, mechanical equipment, clean room, and personnel work areas.[95] The concrete block Operations Support Building was set on a concrete foundation and topped by a flat roof. Although many of the structures at the complex were transferred from NASA back to the USAF in 1973, the Operations Support Building remained under NASA's purview. After the deactivation of the complex, the Operations Support Building served a number of different uses including office space, a hazardous materials storage facility, and a records storage facility. The building was demolished in 2007 or 2008. An Electrical Substation (former Facility No. 21913) and a 4,000-gallon Septic Tank (former Facility No. 21900M) served the Operations Support Building.[96]

Three Hazardous Waste Storage Sheds (former Facilities No. 21917, No. 21918, and No. 21919) were located west of the Operations Support Building. All three, constructed in 1994, were metal buildings with metal roofs and set on concrete foundations with 50 square feet of space.[97] The sheds were removed between 2003 and 2005.

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[93] Master Planning, *CCAFS Basic Information Guide;* United States Air Force, Property Cards 01-21900, 21912, and 21916, Launch Complex 34 files.

[94] United States Air Force, Property Cards 01-21900 and 21934, Launch Complex 34 files.

[95] *Technical Facilities Catalog,* 10-10; Office of Manned Space Flight, 2-6; "Launch Complex 34 Facilities: Fact Sheet 05," [8]; United States Air Force, Property Card 01-21900, Launch Complex 34 files; United States Air Force, Voucher No. 63-1123.

[96] Launch Operations Center, [10]; Pan American World Airways, Inc., *Basic Information Guide,* 1981; Master Planning, *CCAFS Basic Information Guide;* United States Air Force, Property Cards 01-21900 and 21900H, Launch Complex 34 files; Engineering and Environmental Planning, *CCAS Basic Information Guide*, 1994; United States Air Force, Voucher No. 63-1123.

[97] Master Planning, *CCAFS Basic Information Guide;* United States Air Force, Property Card 01-21900, Launch Complex 34 files; Engineering and Environmental Planning, *CCAS Basic Information Guide*, 1994.

Paints, Oils, Lubricants, Cleaning Fluids (POLCF) Building (former Facility No. 21900L)

The Paints, Oils, Lubricants, Cleaning Fluids (POLCF) Building (former Facility No. 21900L) was south of the High Pressure Gas Facility on the outer edge of the perimeter road. The POLCF building, with 2,000 square feet of space, was constructed in 1960. Soon after NASA transferred the complex back to the USAF in 1973, this building was removed from the records kept by the Real Property Office in 1974 and thereafter demolished.[98]

Sentry Houses (Facilities No. 21911 and No. 21914)

Two metal Sentry Houses were located at Launch Complex 34. The first Sentry House (Facility No. 21911) was a metal building incorporating 44 square feet of space set on a concrete foundation with a built-up roof. Constructed in 1960 as part of the original complex, this Sentry House was located on the southeast side of the entrance road, across from the Operations Support Building. The second Sentry House (Facility No. 21914) was also a metal building with 44 square feet of space, a concrete foundation, and built-up roof. Located on the northwest side of the entrance road, north of the Operations Support Building, this Sentry House was originally constructed in 1962 as Facility No. 60741. It was relocated through the salvage yard to Complex 34 in July 1968. Used only intermittently after the complex was abandoned in 1973, both Sentry Houses were demolished by 2000.[99]

Administration Office

In 1965, NASA installed ten 12'-0" x 56'-0" metal trailers joined together to form an Administration Office. After the complex was deactivated, the trailers were relocated to Launch Complex 30 as Facility No. 56920M in 1972.[100]

ADDITIONAL GROUND SUPPORT EQUIPMENT

The Communications System at Launch Complex 34 consisted of closed-circuit television, a Norcom two-wire intercom system of 300 units, and a paging system integrated with other

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[98] United States Air Force, Property Card 01-21900, Launch Complex 34 files; United States Air Force, Voucher Nos. 62-1369 and 75-1006.

[99] United States Air Force, Property Cards 01-21900, 21911 and 21914, Launch Complex 34 files; Pan American World Airways, Inc., *Basic Information Guide, 1981*.

[100] United States Air Force, Property Card 21950, Launch Complex 34 files.

systems by means of a switching system. The closed-circuit television system incorporated 20 television monitors and 11 cameras which had complete mass switching capability from the Blockhouse. Cameras provided numerous views of prelaunch activities throughout the complex. In addition, several control panels throughout the complex were tied into computer systems at the Mission Control Center in Houston, the worldwide tracking network at the Goddard Space Flight Center, and offices in Washington, D.C.[101]

Electrical, water, and fire-suppression systems supported the activities at Launch Complex 34. In addition to the primary support structures, cabling and pipeline connected the structures to form a cohesive complex. Cabling and pipeline included 11,186' of water distribution system, 4,719' of sewage disposal system, 4,730' of grounding system, 40,399' of power lines, and 3,112' of lines for the High Pressure Gas System, as well as the cableway system itself.[102]

MODIFICATIONS AND DEACTIVATION

Initially constructed to launch the Saturn I, Launch Complex 34 was the site of four Saturn I launches between October 1961 and March 1963 (Figure 22). In November 1963, the USAF transferred the complex to NASA. The USAF and NASA modified the complex between 1963 and 1965 to launch the Saturn IB, which was first launched in February 1966.[103] The more advanced vehicle configuration led primarily to alterations and upgrades to the fueling systems. Computers, graphic flow-chart panels, lines, and valving at the RP-1 (Facilities No. 18411, No. 18412, and No. 18413) and LOX facilities (No. 21900C) were upgraded and replaced. The mobile storage and vaporizer vehicles utilized to supply gaseous nitrogen and helium to the High Pressure Gas Facility (Facility No. 21935) were eliminated. The batteries were subsequently replenished from the central converter-compressor facility designed to service both Launch Complexes 34 and 37. A new High Pressure Gas Battery (Facility No. 21900U) was constructed east of the Launch Pad in 1963 to provide additional storage space closer to the Launch Pad for the expanded number of high-pressure nitrogen and helium storage batteries necessary for the new vehicle. The entire Liquid Hydrogen Facility (No. 21900Q), including the storage tank, a burn pond, and its associated Electrical Equipment Building (Facility No. 18408), were constructed northeast of the Launch Pad in 1963–1964 for the new configuration. Adjacent to the Liquid Hydrogen Facility, NASA built the High Pressure Gaseous Hydrogen Storage Battery and

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[101] "Launch Complex 34 Facilities: Fact Sheet 05," [8].

[102] United States Air Force, Property Card 01-21900, Launch Complex 34 files.

[103] "Launch Complex 34 Facilities: Fact Sheet 05," [2].

Burn Stack (Facility No. 21900W) in 1965. The Theodolite Building (Facility No. 21915), also known as the Alignment Building, was constructed in 1965 to house a theodolite utilized in maintaining the azimuth alignment. NASA also installed temporary metal trailers to form an Administration Office. Alterations to the Mobile Service Structure included modifying the service platform inserts to conform with the revised configuration of the new vehicle and adding three enclosures, one at the 116' level and two at the 152' level, for measuring and networks activities. Modifications to the Umbilical Tower included the addition of one swing arm to support the Apollo spacecraft and two umbilical swing arms, one to facilitate propellant loading and one for electro-mechanical operations and checkout and to support cables and lines to the vehicle. In addition, the existing holddown and support arms were replaced with new arms to conform to the revised configuration of the new vehicle. The Automatic Ground Control Station facility was modified with a revamped computer room and upgrades to the mechanical equipment to support the Saturn 1B. The Environmental Control System Building was constructed on the Launch Pad to provide conditioned air for the launch vehicle through the Umbilical Tower.

Two concrete-slab Toxic Vapor Disposal Pads were constructed in 1965 south of the Launch Pad and on either side of the road leading from the LOX Facility to the Launch Pad. Short access roads led to the facilities. The west pad (Facility No. 21900BD) was for Oxidizer venting, while the east pad (Facility No. 21900BC) was for RP-1 fuel. By 1967, Launch Complex 34 had reached its mature configuration (Figure 23). A switching station (Facility No. 22001) was added near the existing Sentry House (Facility No. 21911) in 1967. A second Sentry House (Facility No. 21914) was moved to the complex in 1968.[104]

Most of the alterations following the tragedy of Apollo I in January 1967 involved modifications to the spacecraft. The wiring, the escape hatch, the environmental control system, and the space suits were redesigned. The atmosphere in the spacecraft was changed to 60 percent oxygen and 40 percent nitrogen. Fans, water hoses, fire extinguishers, and an escape slide wire were added to the white room. In case of another fire, astronauts and workers could ride the escape slide wire to the ground in seconds.[105]

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[104] Office of Manned Space Flight, 2-9 through 2-11 and Figure 2-1; United States Air Force, Property Cards 01-21900, 21950, and 21915, Launch Complex 34 files; Hartmann, 2003.

[105] Benson and Faherty, 400-401.

The success of the Saturn IB, further development of the Saturn launch vehicle, and the construction of Launch Complex 39 at Kennedy Space Center led to the termination of further Apollo development flights from Launch Complex 34. The Complex was reduced from an operationally ready state to a downmoded configuration in October 1968 and a Phaseout Plan was approved in April 1971.[106] The Complex was mothballed in November 1971, and the Service Structure and Umbilical Tower were razed in April 1972 due to excessive rust and deterioration. Launch Complex 34 was officially abandoned in October 1973 with most of the facilities transferred back to the USAF's control in November 1973. NASA retained control of the Operations Support Building and the Blockhouse, which served as a site for NASA tour stops, until it was transferred back to the USAF in 1986.[107] The former location of the Operations Support Building is now occupied by equipment and two new buildings that are not related historically to Complex 34. The new construction is surrounded by a fence.

Soon after the complex was officially abandoned, many of the structures at the complex were removed from the real property records, demolished, or moved to other complexes. The Umbilical Tower and Service Structure were demolished in 1972. The fuel tanks, pumps, and machinery at the Launch Pad, LOX Facility, LH_2 Facility, Gaseous Hydrogen Facility, High Pressure Gas Facility, High Pressure Gas Battery, and RP-1 Fueling Facility were removed following the deactivation of the complex, along with electrical substations and other miscellaneous equipment. It is not known when the E.C.S. Building was demolished, but it is likely this occurred at the same time as the demolition of the Service Structure and the Umbilical Tower. The trailers which formed the Administration Office were relocated to Launch Complex 30 as Facility No. 56920M in 1972. The POLCF Building was demolished around 1974.[108]

In 1990, the Phased Array Radar Pedestal (Facility No. 22003), Van Shelter (Facility No. 22004), Toilet (Facility No. 22005), Septic Tank (Facility No. 22006), Optical Tracker (Facility No. 22007), and Electrical Substation (Facility No. 22008) were constructed on the southeast side of the entrance to Launch Complex 34. A Shop/Storage Building (Facility No. 22010) was subsequently built in the same area in 1994, followed by two Electrical Substations: Facility No.

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[106] "LC-34/37 Phaseout Plan," (John F. Kennedy Space Center: National Aeronautics and Space Administration, 1971), Prologue, Archives, Kennedy Space Center, LOC 31B.6, Box 2.

[107] Master Planning, *CCAFS Basic Information Guide;* Cleary, "Launch Facilities & Programs: Complexes 34 and 37"; United States Air Force, Property Cards 01-21900 and 21934, Launch Complex 34 files; Butowsky, National Register Nomination, 7:17.

[108] United States Air Force, Property Cards 01-21900 and 21950, Launch Complex 34 files; United States Air Force, Voucher Nos. 75-1006 and 75-1104.

26005 in 1999 and Facility No. 21933 in 2006. These facilities, which are not historically part of Launch Complex 34, are now inactive, and the radar has been removed.[109] Three Hazardous Waste Storage Sheds (Facilities No. 21917, No. 21918, and No. 21919) were constructed west of the Operations Support Building as part of NASA's operations in 1994.[110] These storage sheds were demolished between 2003 and 2005, and the Operations Support Building was demolished in 2007 or 2008. Used only intermittently after the complex was abandoned in 1973, both Sentry Houses were demolished by 2000.[111]

Launch Complex 34 was listed as part of the Cape Canaveral Air Force Station National Historic Landmark District on April 16, 1984. In honor of the astronauts lost in Apollo 1 and the goals achieved at Launch Complex 34, a Historical Site Kiosk (Facility No. 21801) was erected on the Launch Pad in 1987.[112] Although the equipment has been removed, the Launch Pad and Launch Pedestal, the Blockhouse, the concrete structures and blast walls of the fueling facilities, the Flume and Skimming Basin, the Amplifier Facility and Cableway, the Theodolite Building, the High Pressure Gas Facility, the RP-1 buildings, the Liquid Hydrogen Electrical Equipment Building, and the road network remain in place, and the Flame Deflectors remain parked in their service area (Figure 24).

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[109] United States Air Force, Property Cards 22003, 22004, 22005, 22006, 22007, 22008, 22010, and 26005, Launch Complex 34 files.

[110] Master Planning, *CCAFS Basic Information Guide;* United States Air Force, Property Card 01-21900, Launch Complex 34 files.

[111] United States Air Force, Property Cards 21911 and 21914, Launch Complex 34 files.

[112] United States Air Force, Property Card 21801, Launch Complex 34 files.

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HISTORIC DRAWINGS

As of 2016, the technical drawings used for research in this study have not been cleared for release to the public domain. It is, therefore, not possible to reproduce in this document the drawings that were used to gather information about the design, construction, and use of facilities at Launch Complex 34, CCAFS.

APPENDIX: FIGURES FROM DATA PAGES

Figure 1. Location of Launch Complex 34, CCAFS. U.S. Air Force Space and Missile Museum.

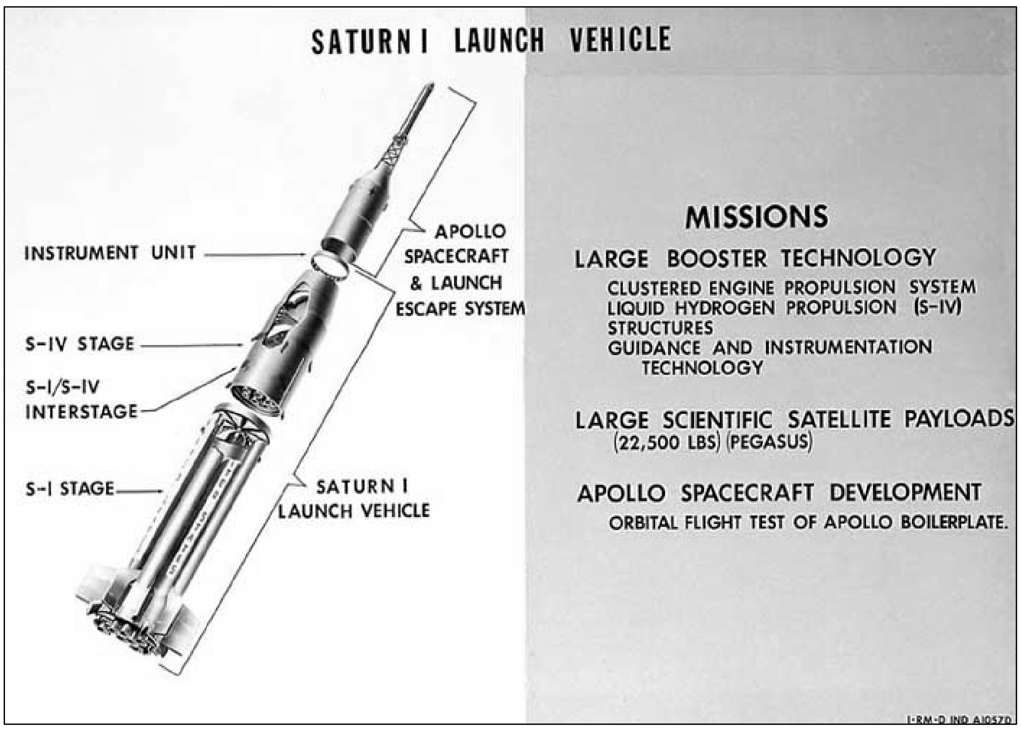

Figure 2. Saturn I Launch and Missile Statement. Appendix A, Figure 1, NASA History Office, http://history.nasa.gov/MHR-5/Images/figa-1.jpg.

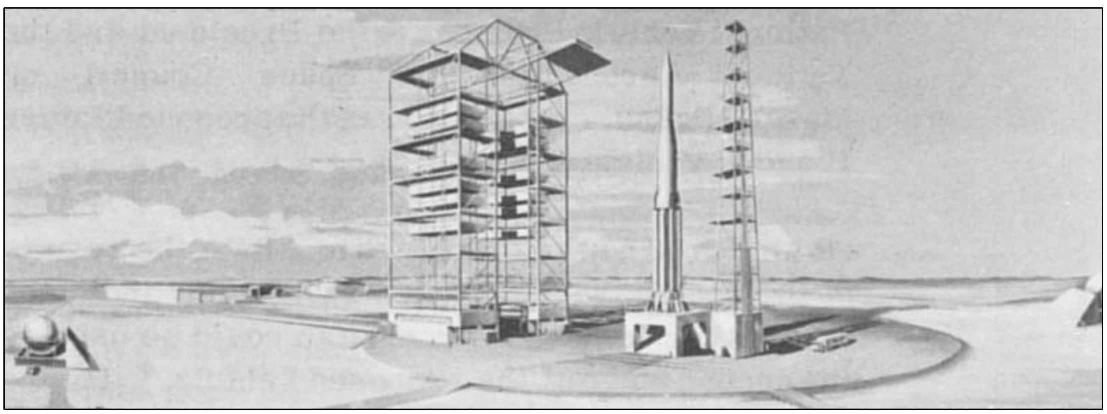

Figure 3. Preliminary Concept of Launch Complex 34. Figure 5, NASA History Office, http://history.nasa.gov/MHR-5/Images/fig005.jpg.

Figure 4. Saturn 1 (SA-1) on launch pad before first launch of a Saturn vehicle, October 27, 1961. NIX (Document) ID: MSFC-6123821, NASA Information Exchange, https://mix.msfc.nasa.gov/IMAGES/MEDIUM/6123821.jpg.

Figure 5. Fourth Launch of Saturn I, March 28, 1963. NIX (Document) ID: MSFC-6413722, NASA Information Exchange, https://mix.msfc.nasa.gov/IMAGES/MEDIUM/6413722.jpg.

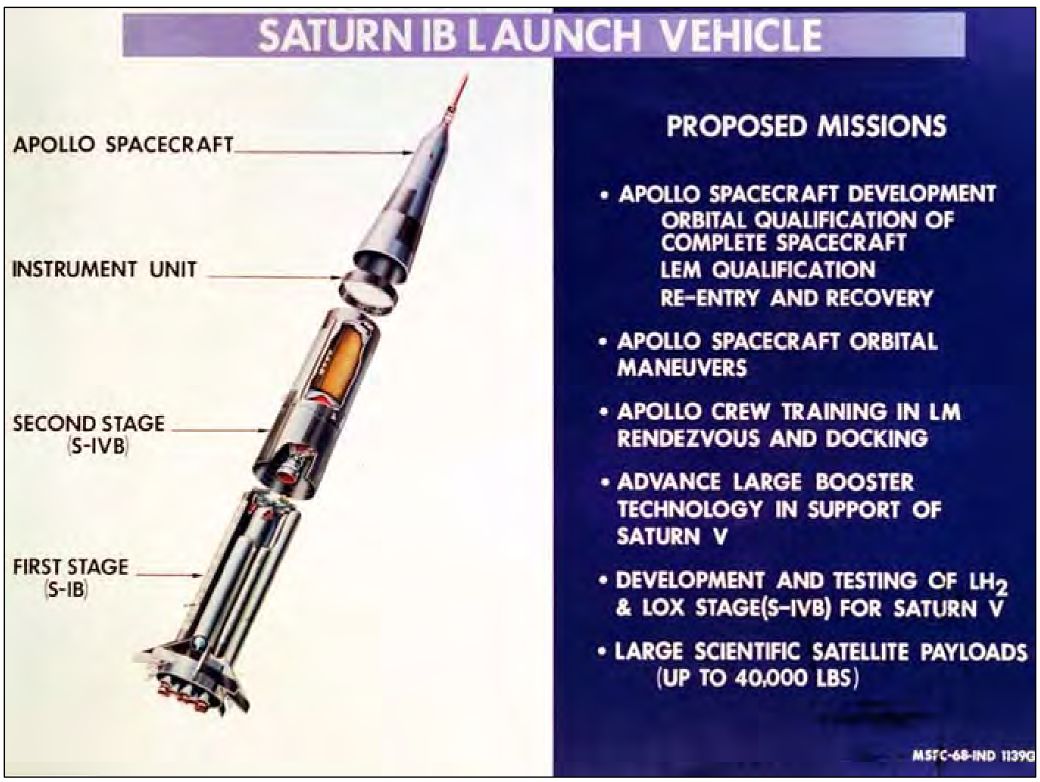

Figure 6. Saturn IB Launch Vehicle and Missile Statement. Appendix A, Figure 2, NASA History Office, http://history.nasa.gov/MHR-5/Images/figa-2.jpg.

Figure 7. First Launch of Saturn IB, February 26, 1966. Figure 276, NASA History Office, http://history.nasa.gov/MHR-5/Images/fig276.jpg.

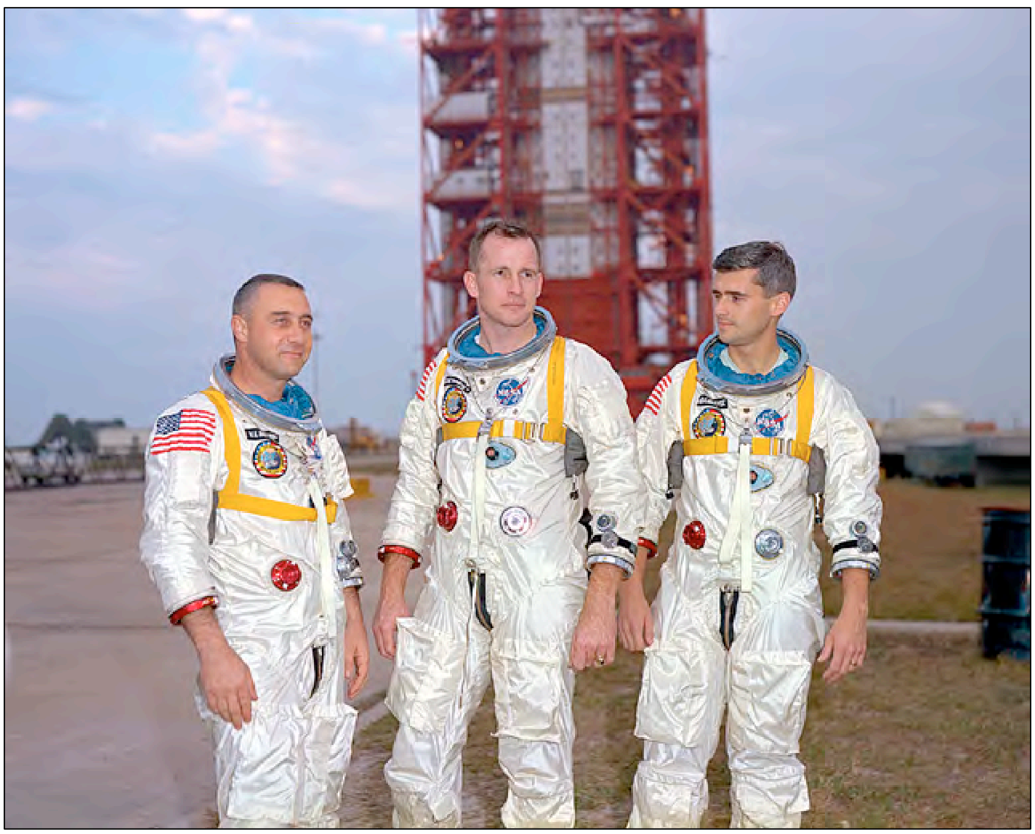

Figure 8. Apollo I astronauts in front of Pad at Launch Complex 34, January 17, 1967. NIX (Document) ID: S67-19770, NASA Information Exchange, http://grin.hq.nasa.gov/IMAGES/SMALL/GPN-2000-000618.jpg.

Figure 9. Launch of Apollo 7, Apollo's first manned launch, October 11, 1968. Photograph 568-48787, Johnson Space Center, Office of Public Affairs, http://images.jsc.nasa.gov/lores/S68-48787.jpg.

Figure 10. President John F. Kennedy and officials in briefing in second floor of Blockhouse, September 11, 1962. Photo 62C-1443, Kennedy Space Center, Great Images in NASA, http://grin.hq.nasa.gov/IMAGES/SMALL/GPN-2000-000605.jpg.

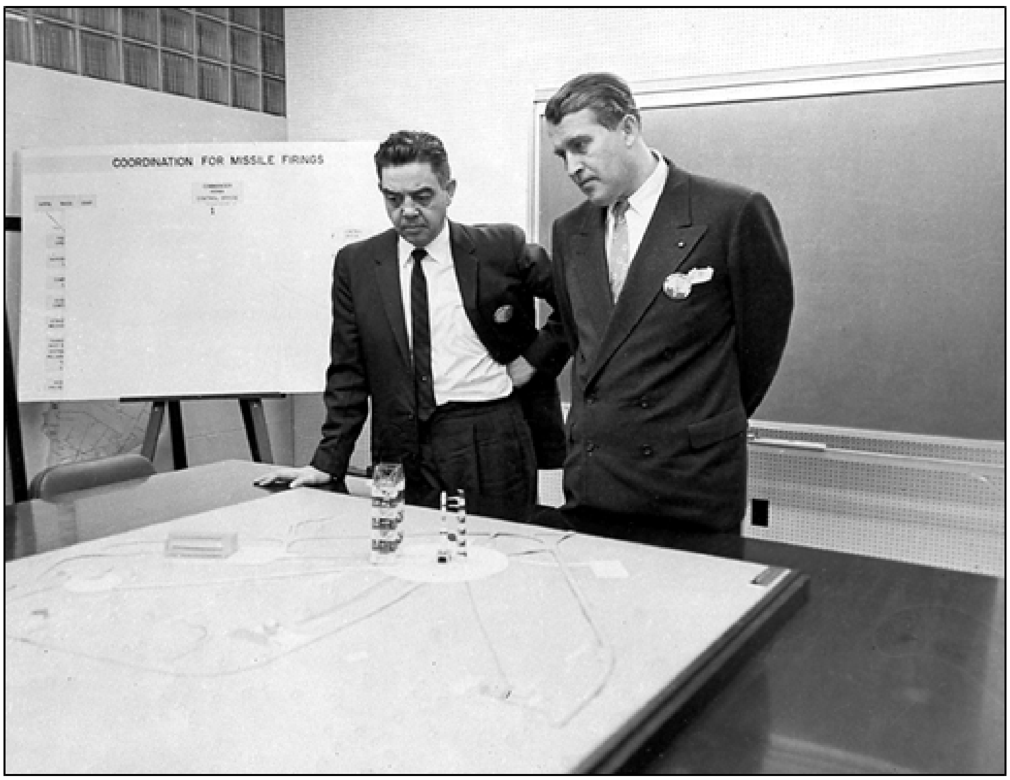

Figure 11. Dr. von Braun and Don Ostrander, head of the Launch Vehicle Program at NASA Headquarters, look at a model of Launch Complex 34 in 1960. NIX (Document) ID: MSFC-6517782, NASA Information Exchange, https://mix.msfc.nasa.gov/IMAGES/MEDIUM/6517782.jpg.

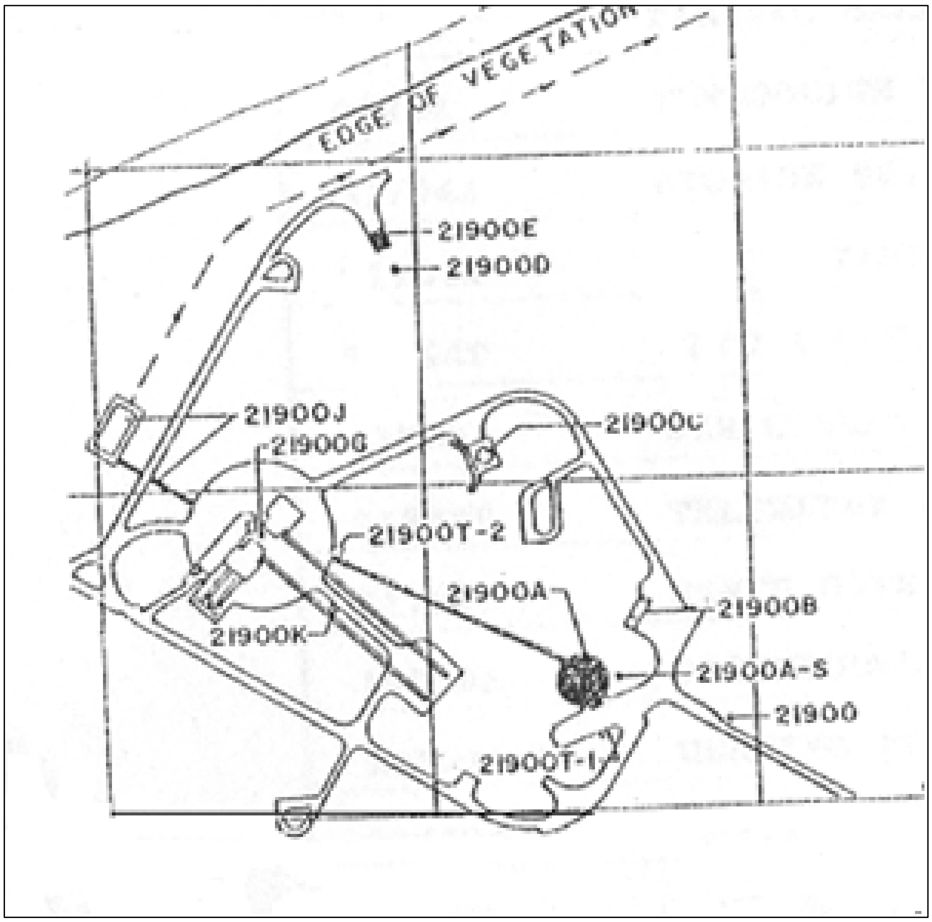

Figure 12. Launch Complex 34, 1960. Basic Information Guide, Pan American World Airways, Inc.

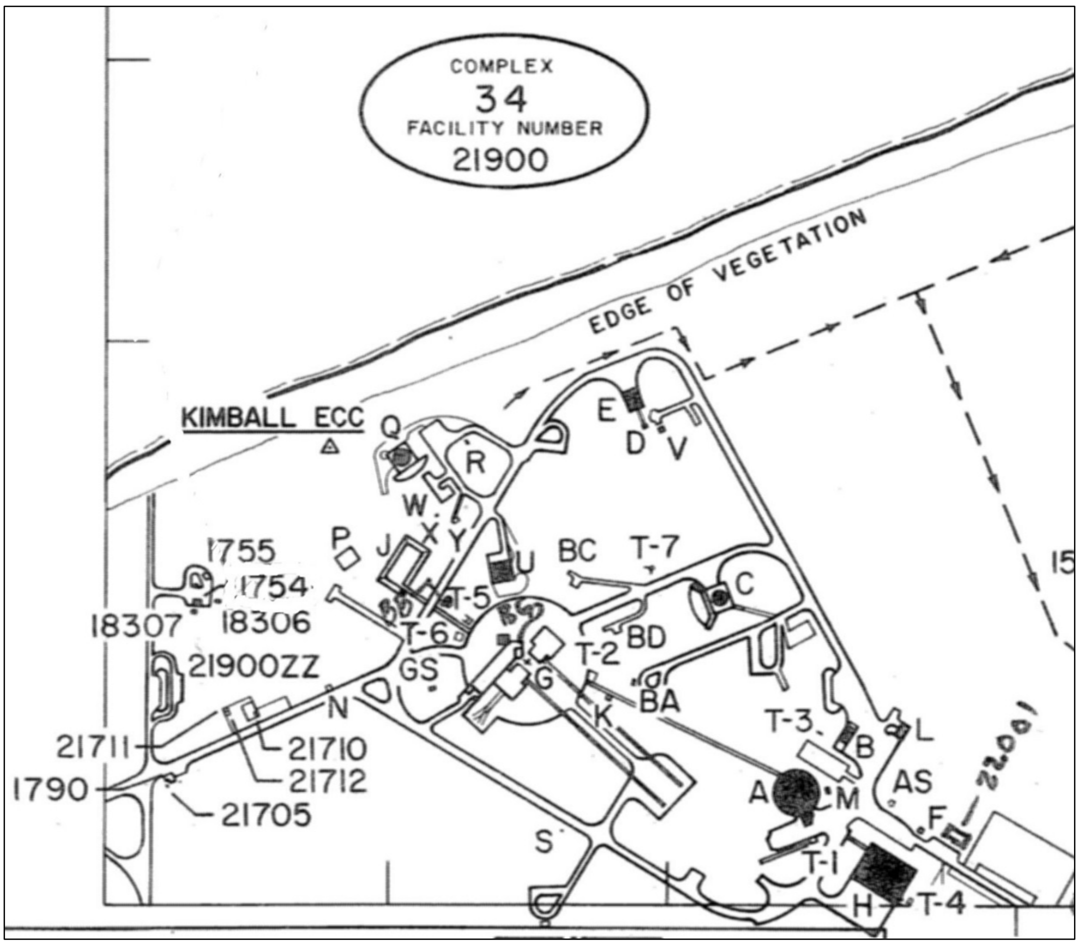

Figure 13. Launch Complex 34, 1967. Basic Information Guide, Pan American World Airways, Inc.

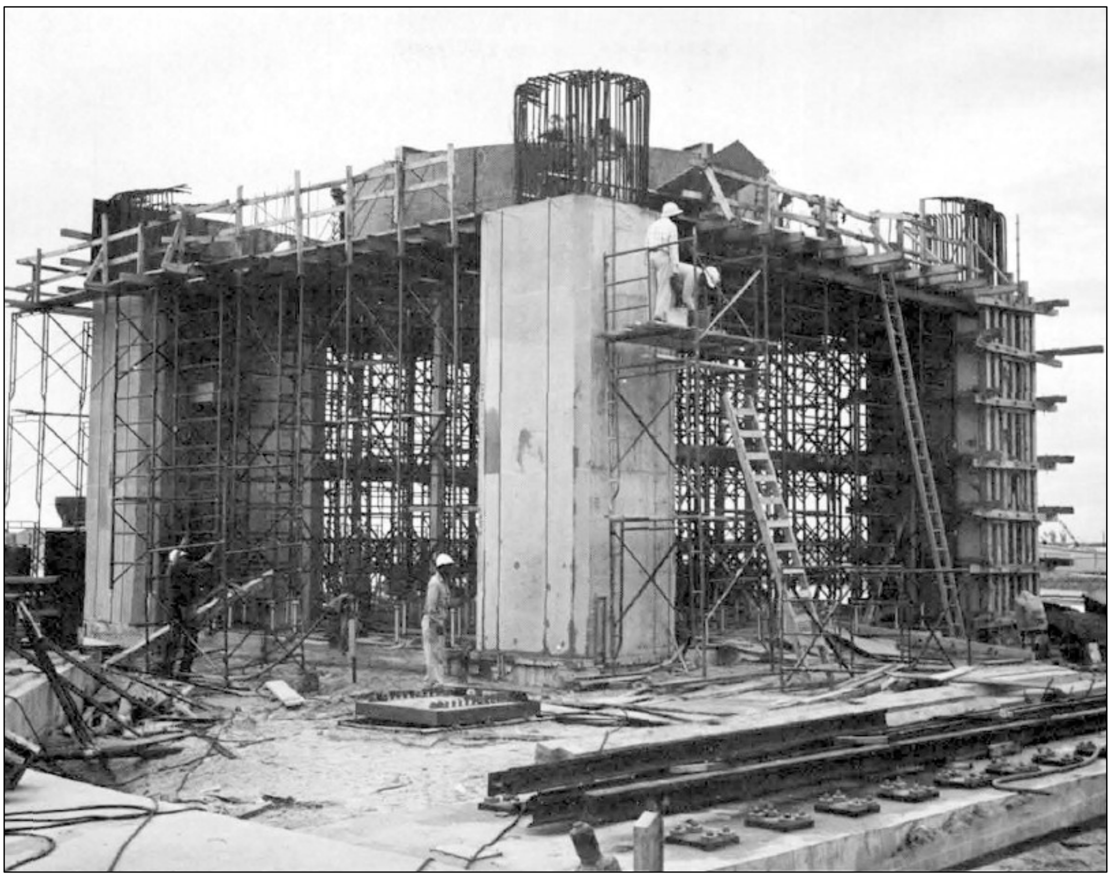

Figure 14. Construction of Launch Pedestal at Complex 34, 1960. Figure 6, Benson and Faherty, *Moonport*.

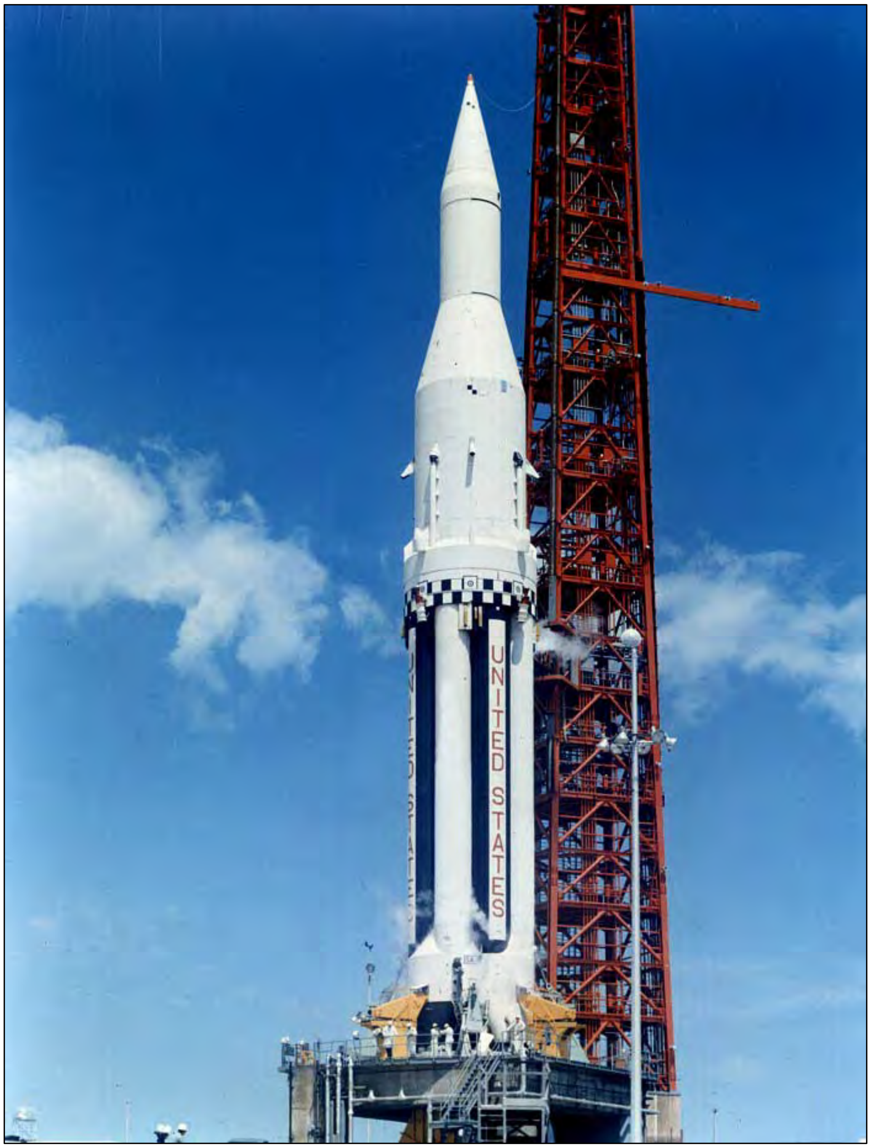

Figure 15. Saturn I on Launch Pedestal with Umbilical Tower, in preparation for March 28, 1963 launch. Figure 122, NASA History Office, http://history.nasa.gov/MHR-5/Images/fig122.jpg.

Figure 16. Launch Pad, Umbilical Tower, Environmental Control System Building, and Mobile Service Structure 1965. Figure 239, NASA History Office, http://history.nasa.gov/MHR-5/Images/fig239.jpg.

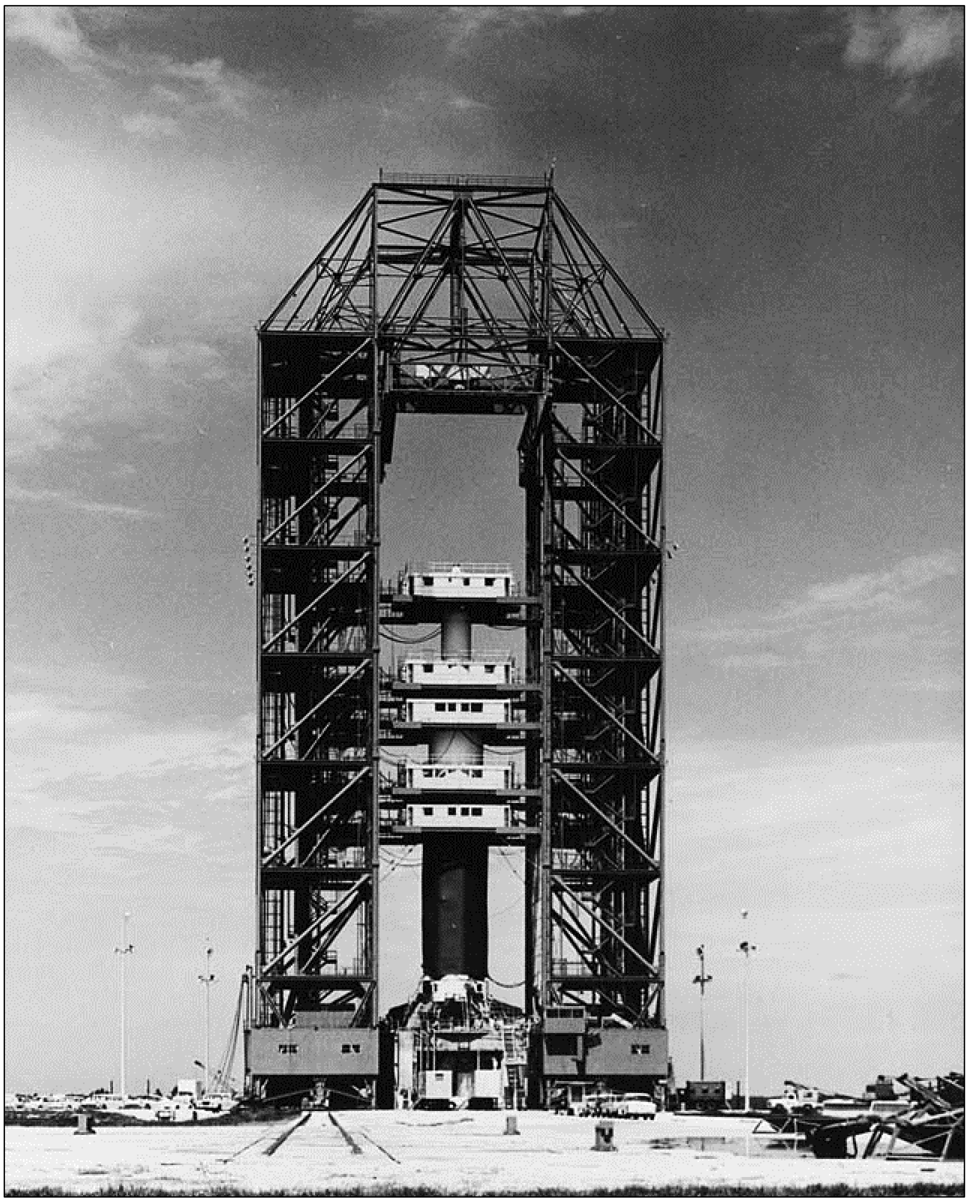

Figure 17. Saturn I on Launch Pedestal surrounded by Mobile Service Structure, Fall 1961. Figure 81, NASA History Office, http://history.nasa.gov/MHR-5/Images/fig081.jpg.

Figure 18. Liquid Oxygen Facility at Complex 34, date unknown. Figure 11, Benson and Faherty, *Moonport*.

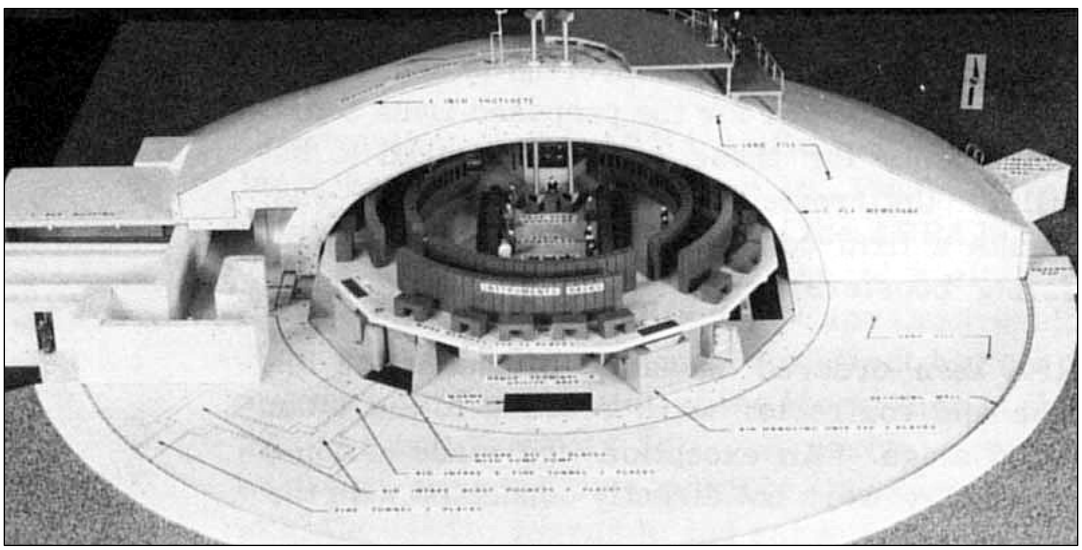

Figure 19. Model of Blockhouse, Launch Complex 34, date unknown. Figure 11, NASA History Office, http://history.nasa.gov/MHR-5/Images/fig011.jpg.

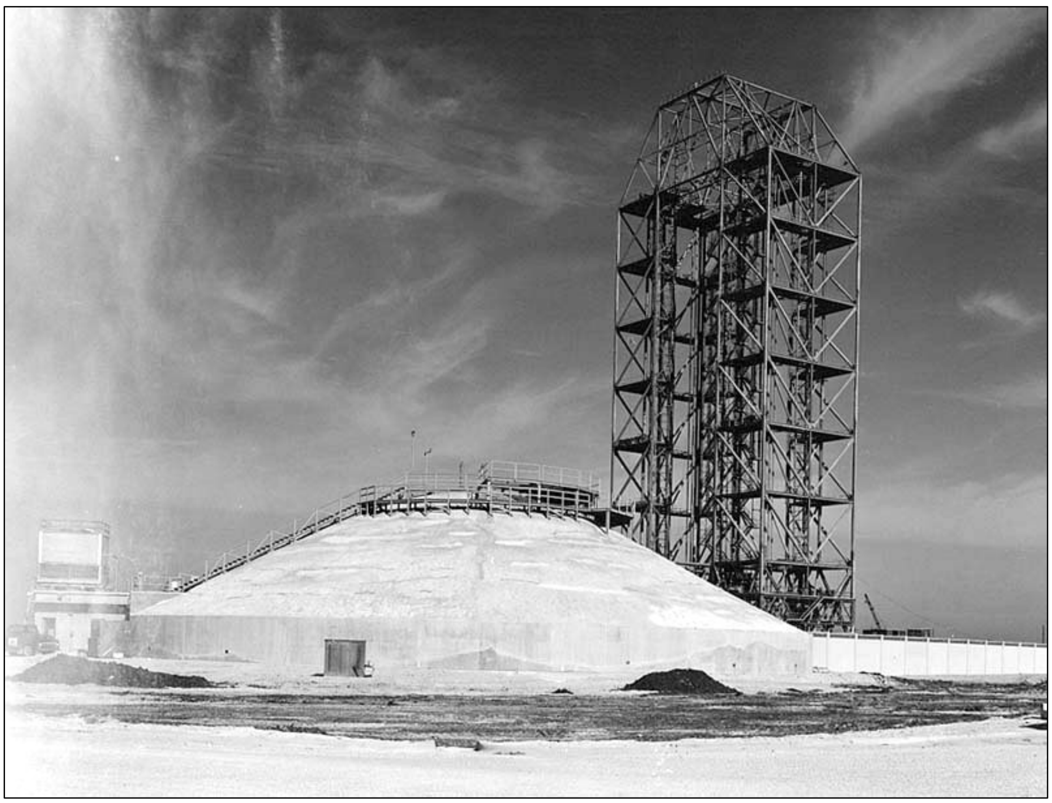

Figure 20. Blockhouse and Mobile Service Structure under construction, 1960-1961. Figure 38, NASA History Office, http://history.nasa.gov/MHR-5/Images/fig038.jpg.

Figure 21. Blockhouse, Interior of Second floor, date unknown. Figure 59, NASA History Office, http://history.nasa.gov/MHR-5/Images/fig059.jpg.

Figure 22. Aerial view of Launch Complex 34 from north, 1961. Figure 58, NASA History Office, http://history.nasa.gov/MHR-5/Images/fig058.jpg.

Figure 23. Aerial view of Launch Complex 34 from east, ca. 1967. Figure 334, NASA History Office, http://history.nasa.gov/MHR-5/Images/fig334.jpg.

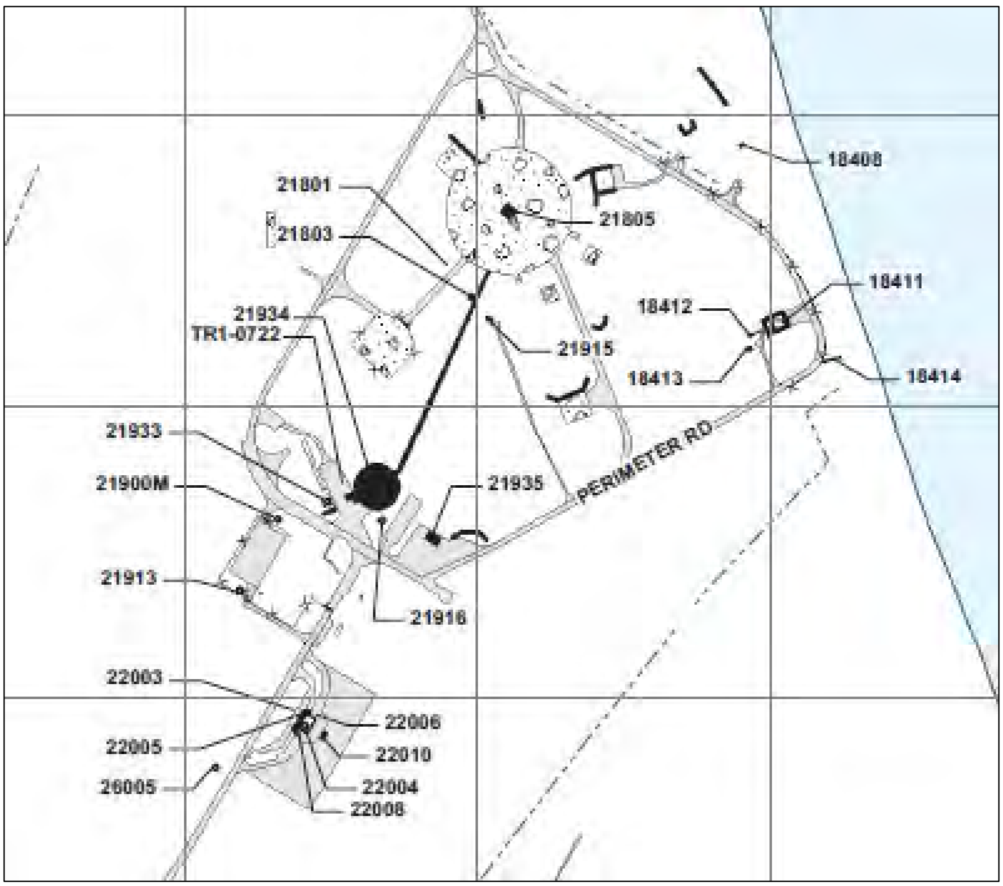

Figure 24. Launch Complex 34, 2008. Basic Information Guide, SGS Master Planning, Cape Canaveral Air Force Station/Kennedy Space Center.

CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 34
17251 Freedom Road
Cape Canaveral
Brevard County
Florida

HAER No. FL-8-6

PHOTOGRAPHS

HISTORIC AMERICAN ENGINEERING RECORD
Southeast Regional Office
National Park Service
U. S. Department of the Interior
100 Alabama Street, S.W.
Atlanta, GA 30303

HISTORIC AMERICAN ENGINEERING RECORD

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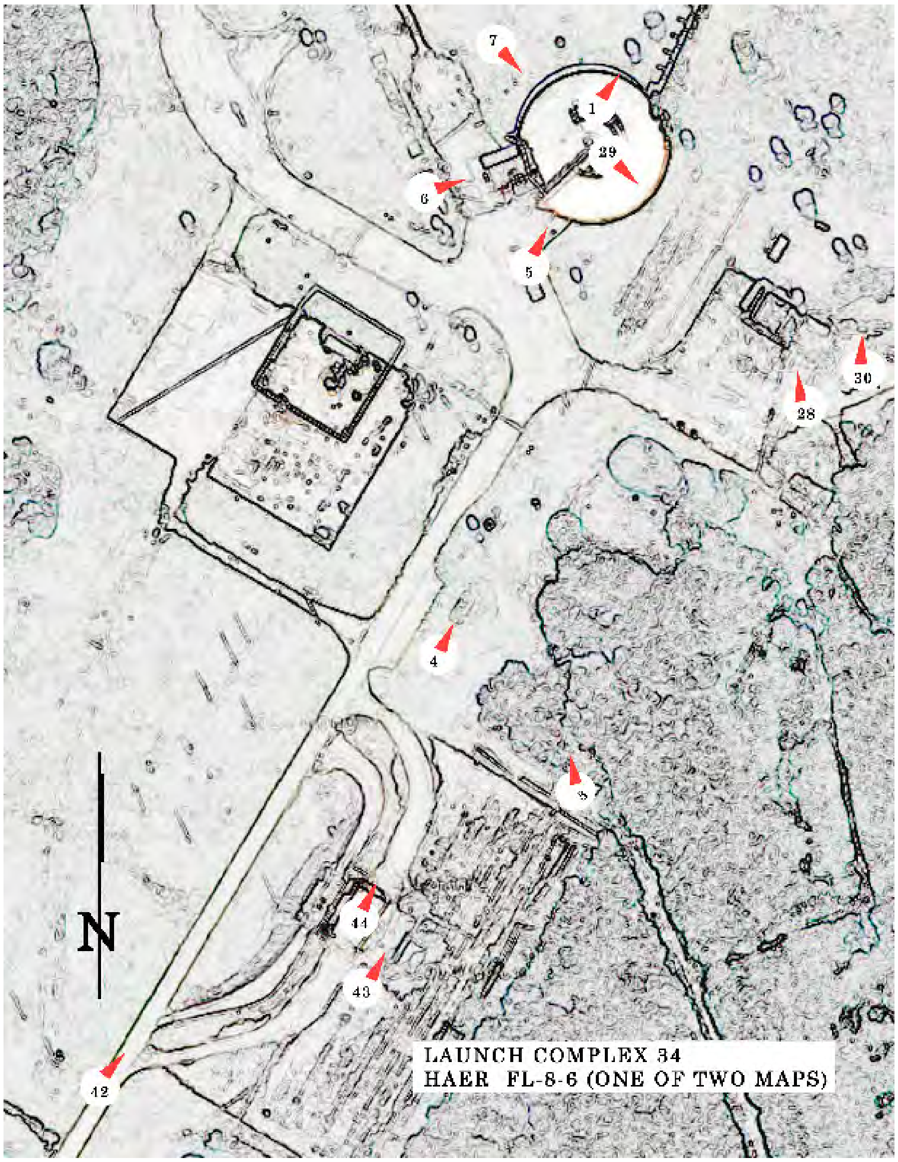
LAUNCH COMPLEX 34
17251 Freedom Road
Cape Canaveral
Brevard County
Florida

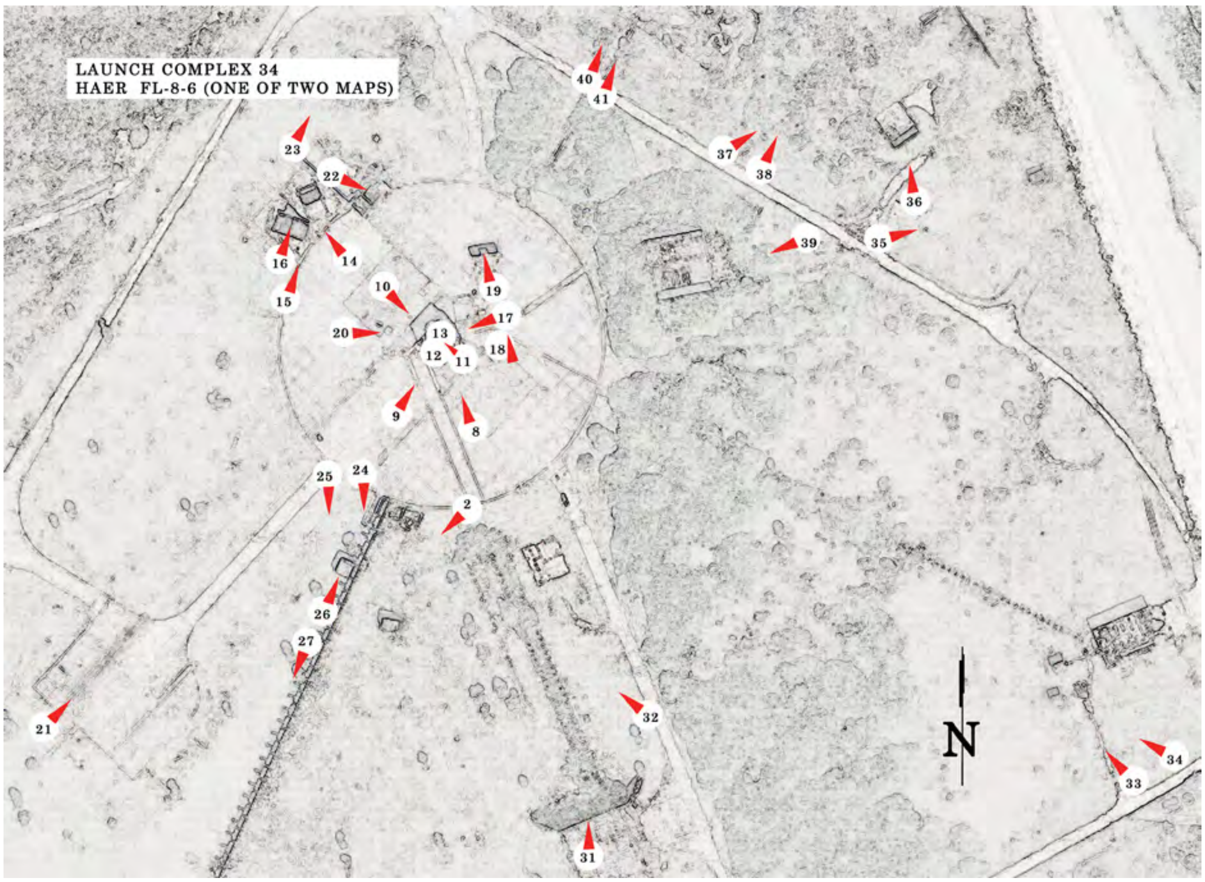
INDEX TO BLACK AND WHITE PHOTOGRAPHS

Photographer: Martin Stupich, 2014
See photo key on pages 2 and 3 of Index to Photographs

FL-8-6-1	FROM BLOCKHOUSE ROOF, VIEW EAST SHOWING CONCRETE CABLEWAY STRUCTURE CONNECTING BLOCKHOUSE TO PAD; VIEW TO NORTHEAST (on photo key as #1)
FL-8-6-2	CONCRETE MASONRY UNIT WALL AT CABLEWAY; VIEW TO WEST (on photo key as #2)
FL-8-6-3	THRUST BLOCK NEAR WEST ENTRANCE, VIEW TO NORTHEAST (on photo key as #3)
FL-8-6-4	ANCILLARY ARTIFACTS NEAR WEST ENTRANCE ROAD: PAD WITH COPPER CABLE STUBS; CONCRETE STRUCTURE WITH LOUVERED SIDES; VIEW TO EAST (on photo key as #4)



Photograph Key 1 for Entire Complex



Photograph Key 2 for Entire Complex

HISTORIC AMERICAN ENGINEERING RECORD
CAPE CANAVERAL AIR FORCE STATION
LAUNCH COMPLEX 34
SEE INDEX TO PHOTOGRAPHS FOR CAPTION
HAER No. FL-8-6-1

HISTORIC AMERICAN ENGINEERING RECORD
CAPE CANAVERAL AIR FORCE STATION
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LAUNCH COMPLEX 34
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HISTORIC AMERICAN ENGINEERING RECORD

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LAUNCH COMPLEX 34, FACILITY No. 21805
(LAUNCH COMPLEX 34, LAUNCH PAD)
17251 Freedom Road
Cape Canaveral
Brevard County
Florida

INDEX TO BLACK AND WHITE PHOTOGRAPHS

Photographer: Martin Stupich, 2014
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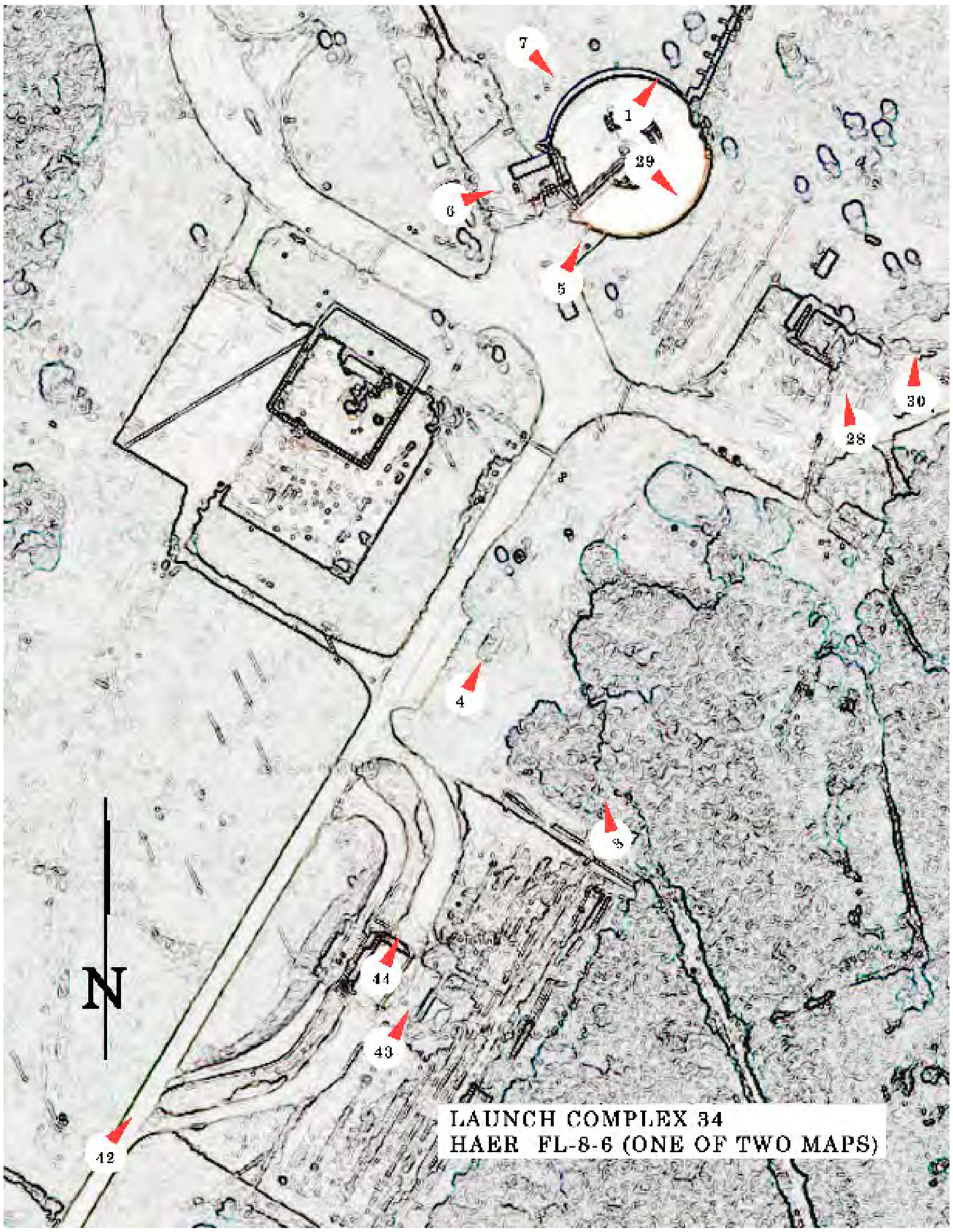
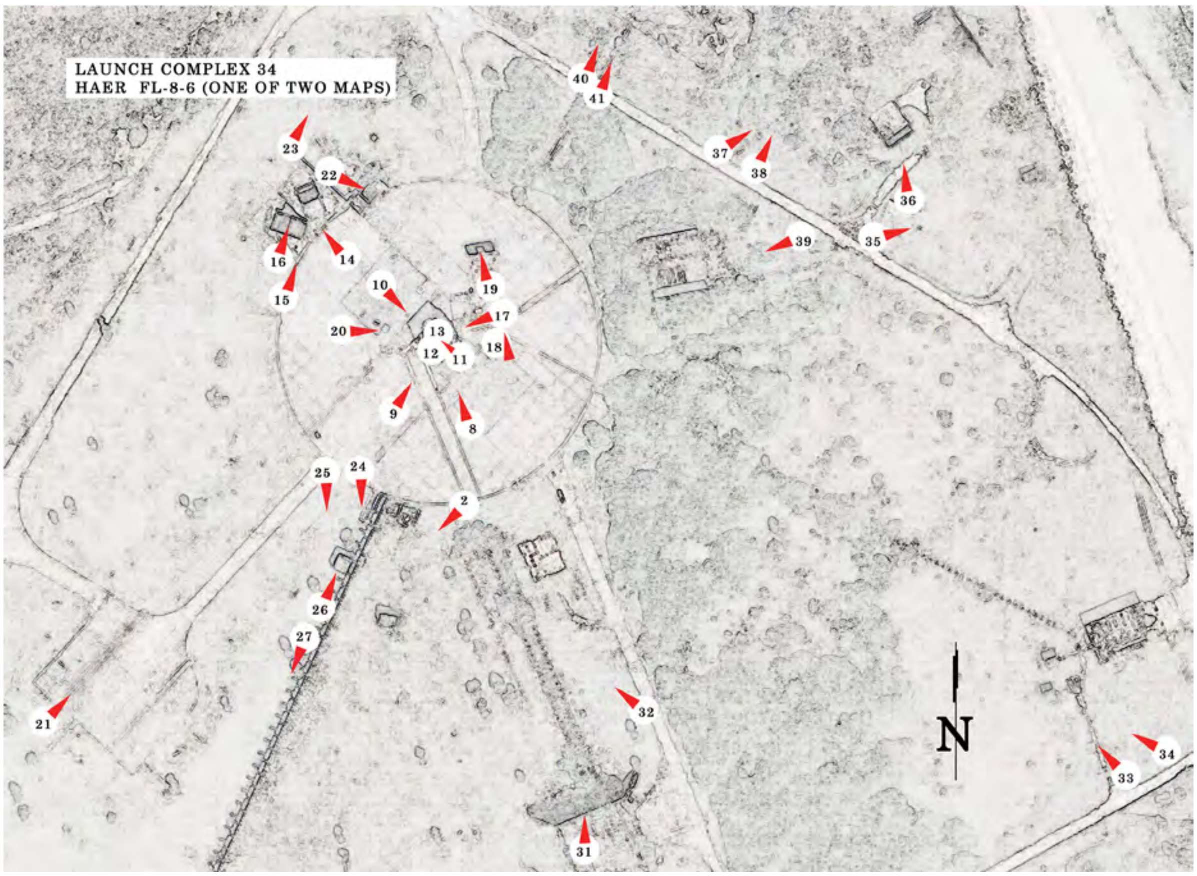
FL-8-6-A-1	GENERAL VIEW OF PAD AREA SHOWING (L-R) FLAME DEFLECTORS, LAUNCH PEDESTAL, AND CONCRETE WALL REMNANT OF ENVIRONMENTAL CONTROL BUILDING; VIEW TO NORTH (IN DISTANCE: LC-37 WITH ROCKET ERECTION IN PROCESS) (on photo key as #8)
FL-8-6-A-2	GENERAL VIEW OF PAD AREA FROM EAST TO WEST (on photo key as #17)
FL-8-6-A-3	FACADE VIEW OF SOUTHWEST FACE OF LAUNCH PEDESTAL, VIEW TO NORTHEAST (on photo key as #9)
FL-8-6-A-4	NORTHWEST FACADE OF LAUNCH PEDESTAL, VIEW IS ON AXIS WITH TRACKS LEADING TO FLAME DEFLECTOR PARKING AREA, VIEW TO SOUTHEAST (on photo key as #10)
FL-8-6-A-5	FROM UNDER LAUNCH PEDESTAL, VIEW TOWARD FLAME DEFLECTORS IN SERVICE AREA; VIEW TO NORTHWEST (on photo key as #11)
FL-8-6-A-6	DETAIL OF LEGS OF LAUNCH PEDESTAL SHOWING STEEL CLADDING AS PROTECTION FROM LAUNCH DISTRESS; VIEW TO NORTHEAST (on photo key as #12)

FL-8-6-A-7	LOOKING DIRECTLY UP THROUGH LAUNCH PEDESTAL; CIRCULAR PIPE IS DELUGE DELIVERY SYSTEM (TOP OF IMAGE IS SOUTHWEST) (on photo key as #13)
FL-8-6-A-8	EMBEDDED TRACKS LEADING TO FLAME DEFLECTOR SERVICE AND PARKING AREA; VIEW TO NORTHWEST (on photo key as #14)
FL-8-6-A-9	FLAME DEFLECTORS PARKED; VIEW TO NORTH (on photo key as #15)
FL-8-6-A-10	FLAME DEFLECTOR DETAIL SHOWING STEEL ELEMENTS BOLTED TOGETHER; VIEW TO EAST (on photo key as #16)
FL-8-6-A-11	GENERAL VIEW OF UMBILICAL TOWER AREA; (NOTE LC-37 GANTRY PROJECTING ABOVE LEFT UPPER WALL); VIEW TO NORTH (on photo key as #18)
FL-8-6-A-12	REMNANT ELEMENTS OF UMBILICAL TOWER AREA AND ENVIRONMENTAL CONTROL BUILDING, VIEW TO NORTH (on photo key as #19)
FL-8-6-A-13	REMNANT OF DELUGE DELIVERY SYSTEM: VIEW TO EAST (on photo key as #20)
FL-8-6-A-14	ONE OF TWO TWIN TRACKS LEADING FROM MOBILE SERVICE STRUCTURE PARKING AREA TO LAUNCH PEDESTAL; VIEW TO NORTHEAST (on photo key as #21)
FL-8-6-A-15	ACCESS TO SUB-GRADE AUTOMATIC GROUND CONTROL STATION ROOMS; VIEW TO SOUTH (on photo key as #22)
FL-8-6-A-16	BLAST WALL NORTH OF PAD NORTHEAST OF SUB-GRADE ACCESS AREA (on photo key as #23)



Photograph Key 1 for Entire Complex



Photograph Key 2 for Entire Complex

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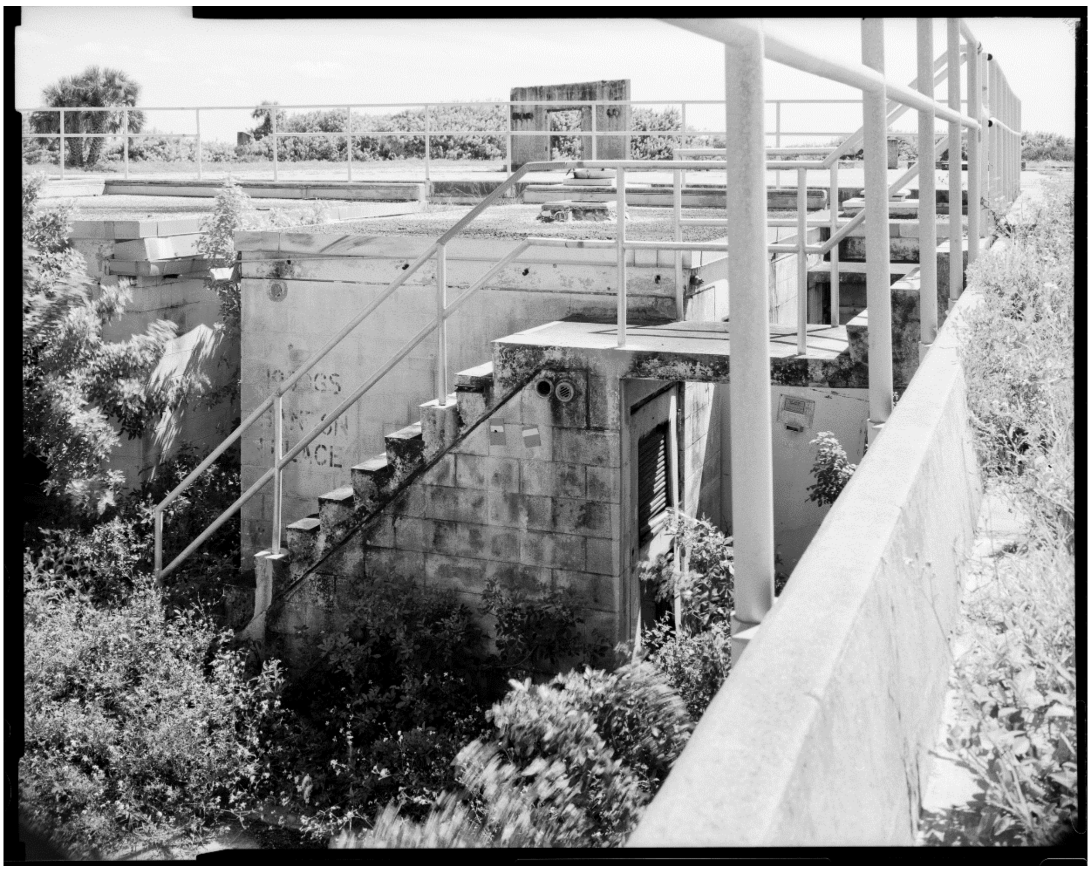

HISTORIC AMERICAN ENGINEERING RECORD
CAPE CANAVERAL AIR FORCE STATION
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(LAUNCH COMPLEX 34, THEODOLITE BUILDING)
17251 Freedom Road
Cape Canaveral
Brevard County
Florida

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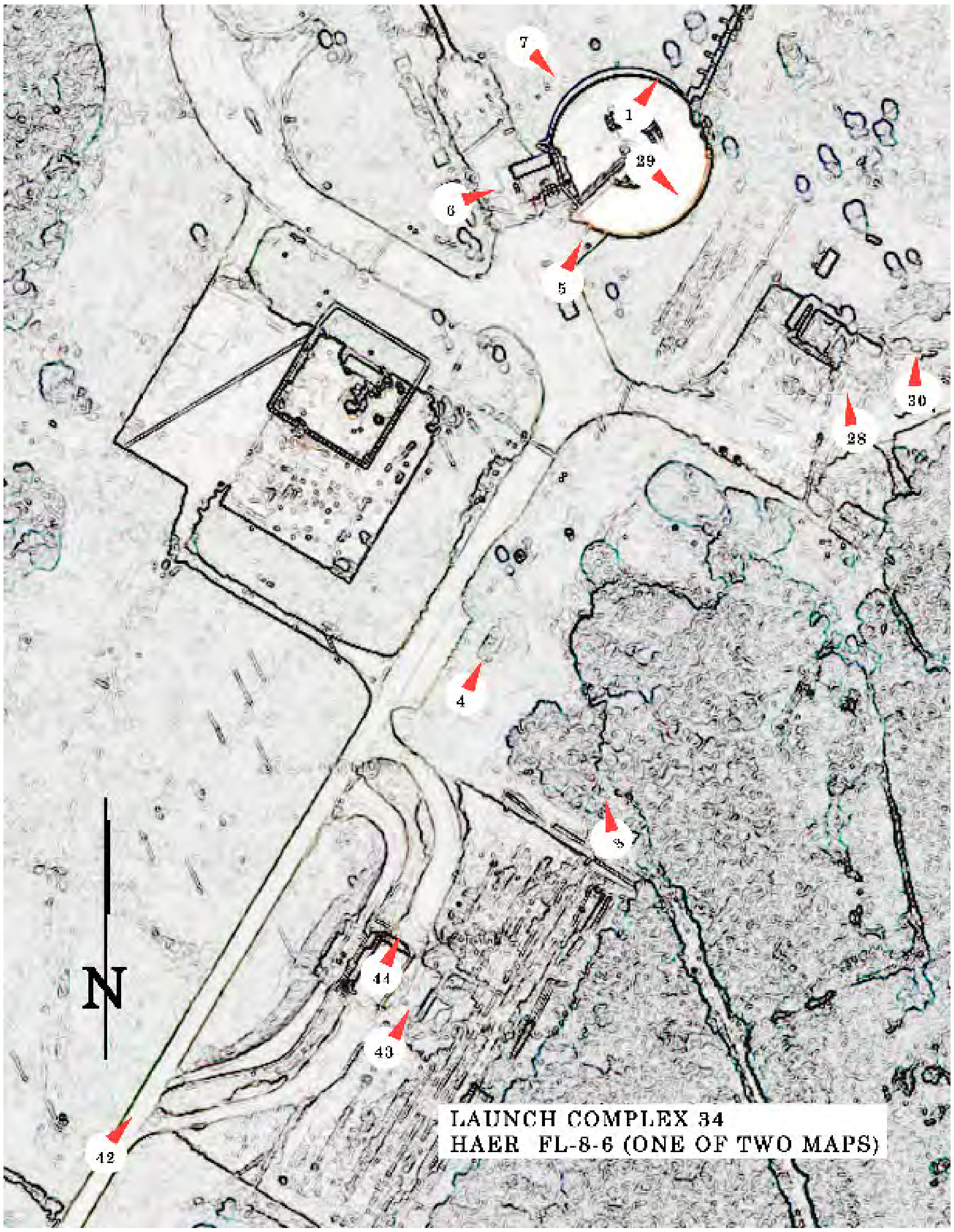
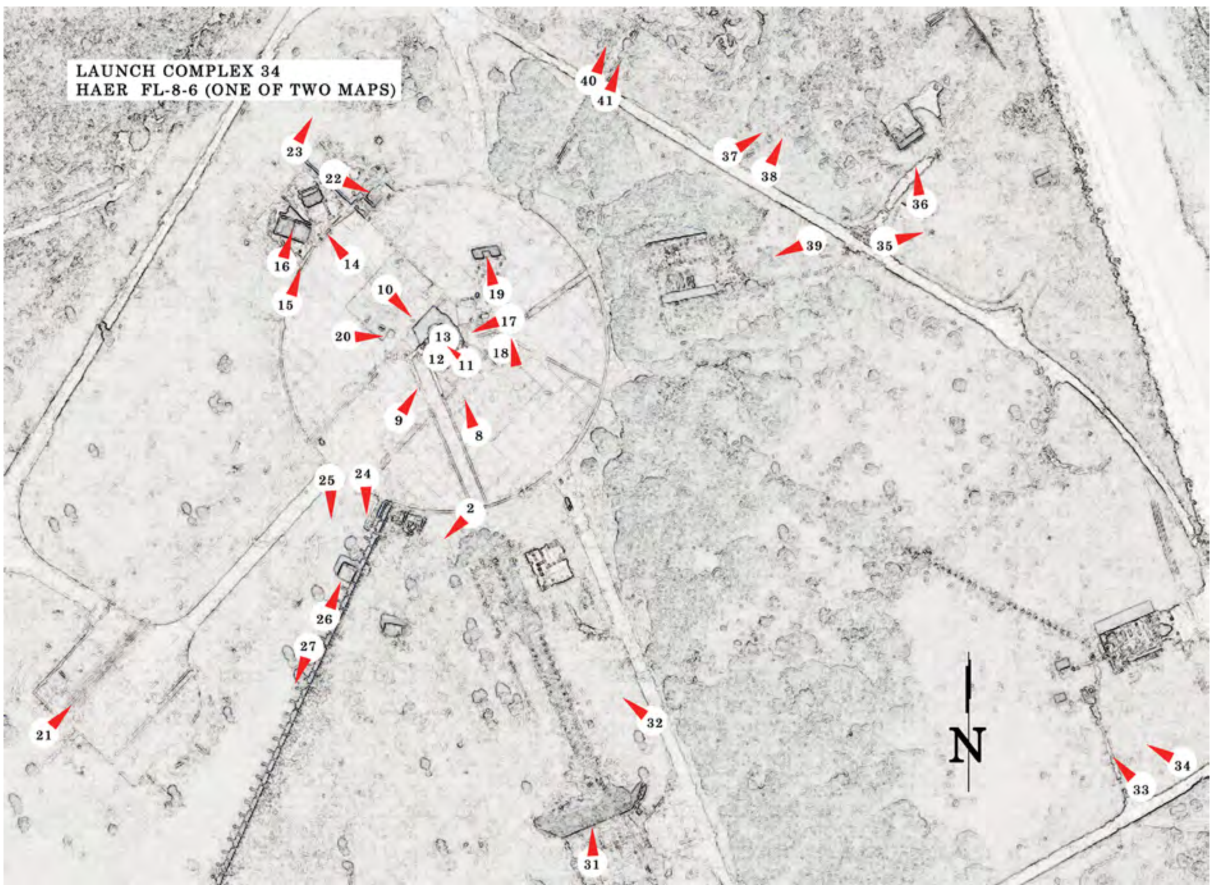
Photographer: Martin Stupich, 2014
See photo key on pages 2 and 3 of Index to Photographs

FL-8-6-B-1	THEODOLITE BUILDING BEYOND CABLEWAY ARMATURE STRUCTURE; VIEW TO SOUTH (on photo key as #24)



Photograph Key 1 for Entire Complex



Photograph Key 2 for Entire Complex

HISTORIC AMERICAN ENGINEERING RECORD
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CAPE CANAVERAL AIR FORCE STATION, HAER No. FL-8-6-C
LAUNCH COMPLEX 34, FACILITY No. 21803
(LAUNCH COMPLEX 34, AMPLIFIER BUILDING/CABLEWAY)
17251 Freedom Road
Cape Canaveral
Brevard County
Florida

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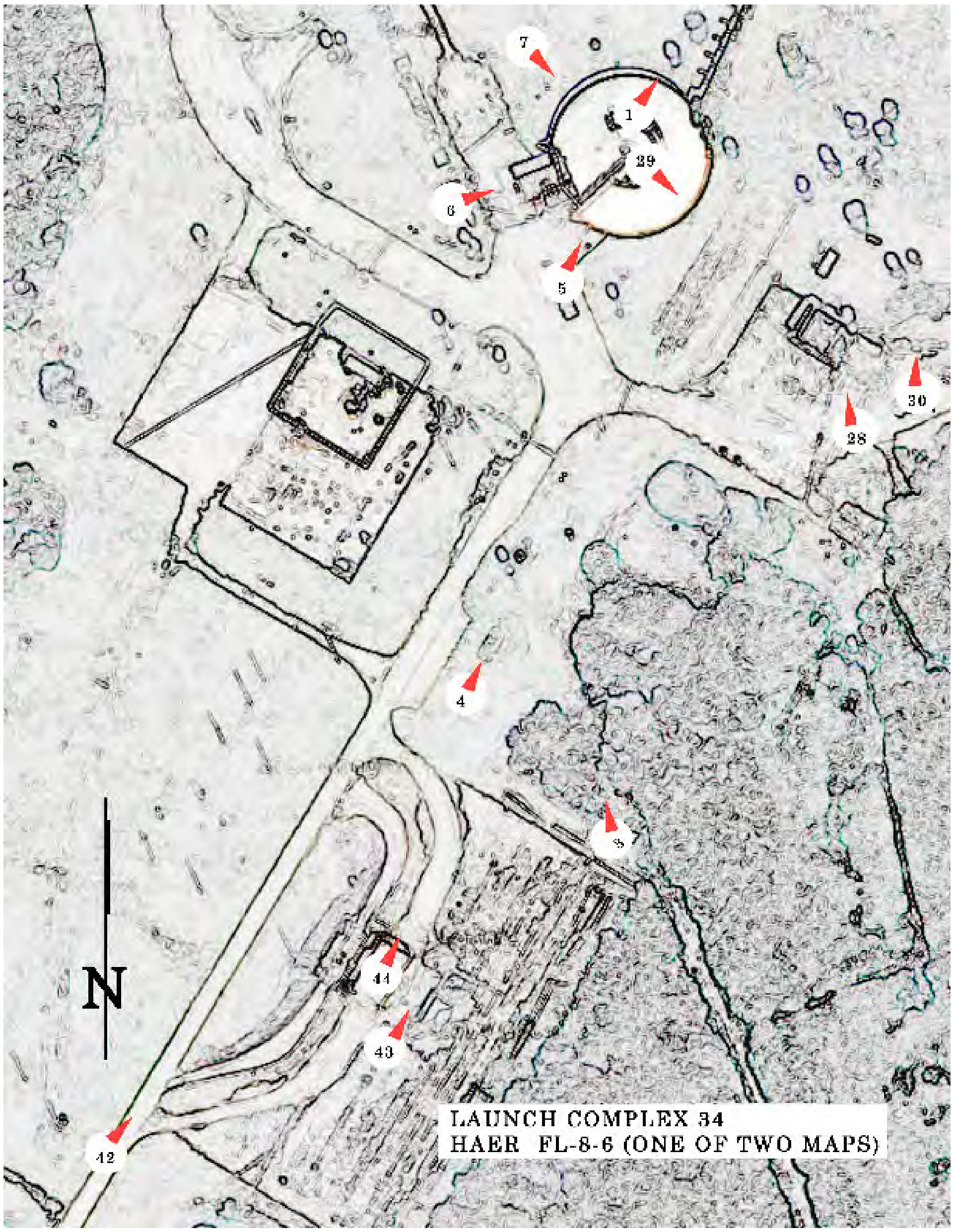
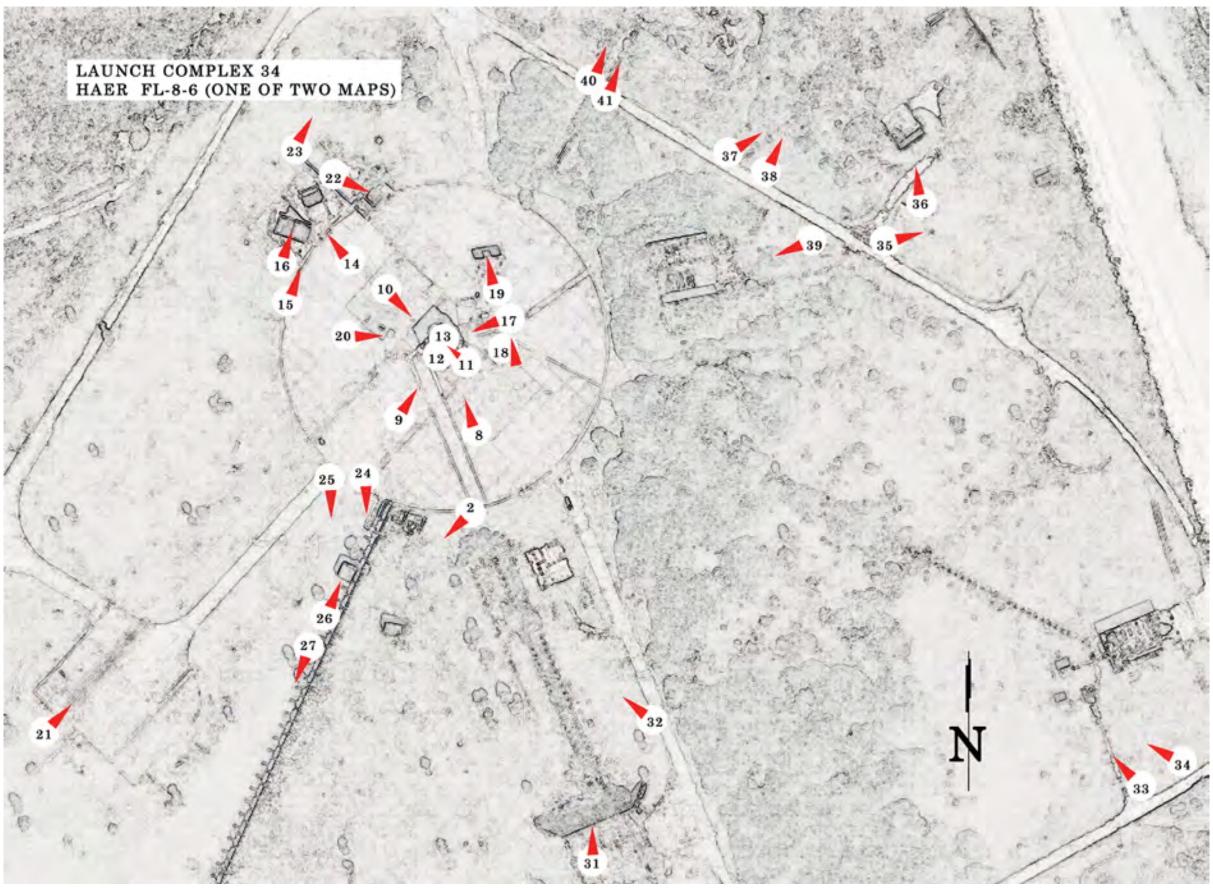
Photographer: Martin Stupich, 2014
See photo key on pages 2 and 3 of Index to Photographs

FL-8-6-C-1	AMPLIFIER FACILITY, VIEW TO SOUTH (on photo key as #25)
FL-8-6-C-2	AMPLIFIER FACILITY FROM CABLEWAY, CLOSE VIEW TO NORTH (on photo key as #26)
FL-8-6-C-3	FROM UNDER CABLEWAY ARMATURE, VIEW TOWARD BLOCKHOUSE IN DISTANCE; VIEW TO SOUTHWEST (on photo key as #27)



Photograph Key 1 for Entire Complex



Photograph Key 2 for Entire Complex

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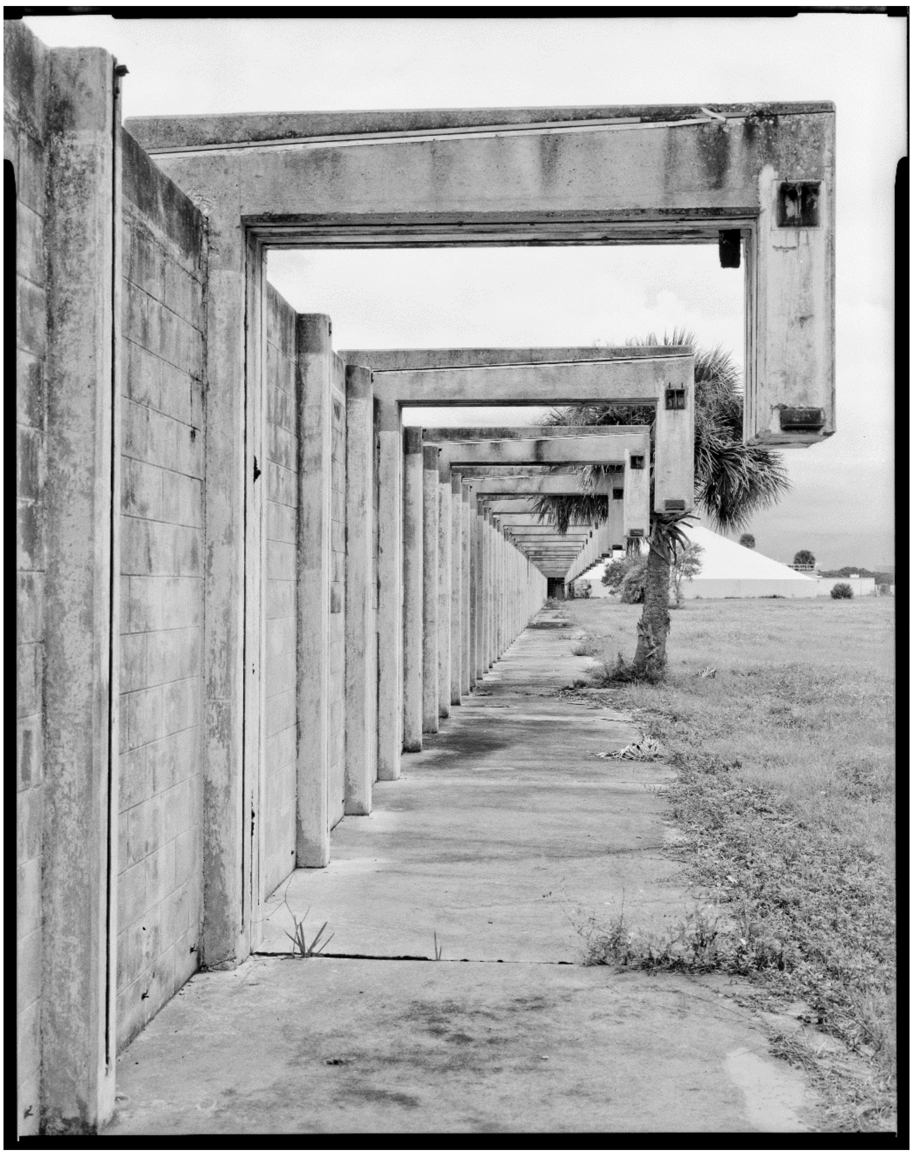

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HISTORIC AMERICAN ENGINEERING RECORD

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CAPE CANAVERAL AIR FORCE STATION, HAER No. FL-8-6-D
LAUNCH COMPLEX 34, FACILITY No. 21934
(LAUNCH COMPLEX 34, BLOCKHOUSE)
17251 Freedom Road
Cape Canaveral
Brevard County
Florida

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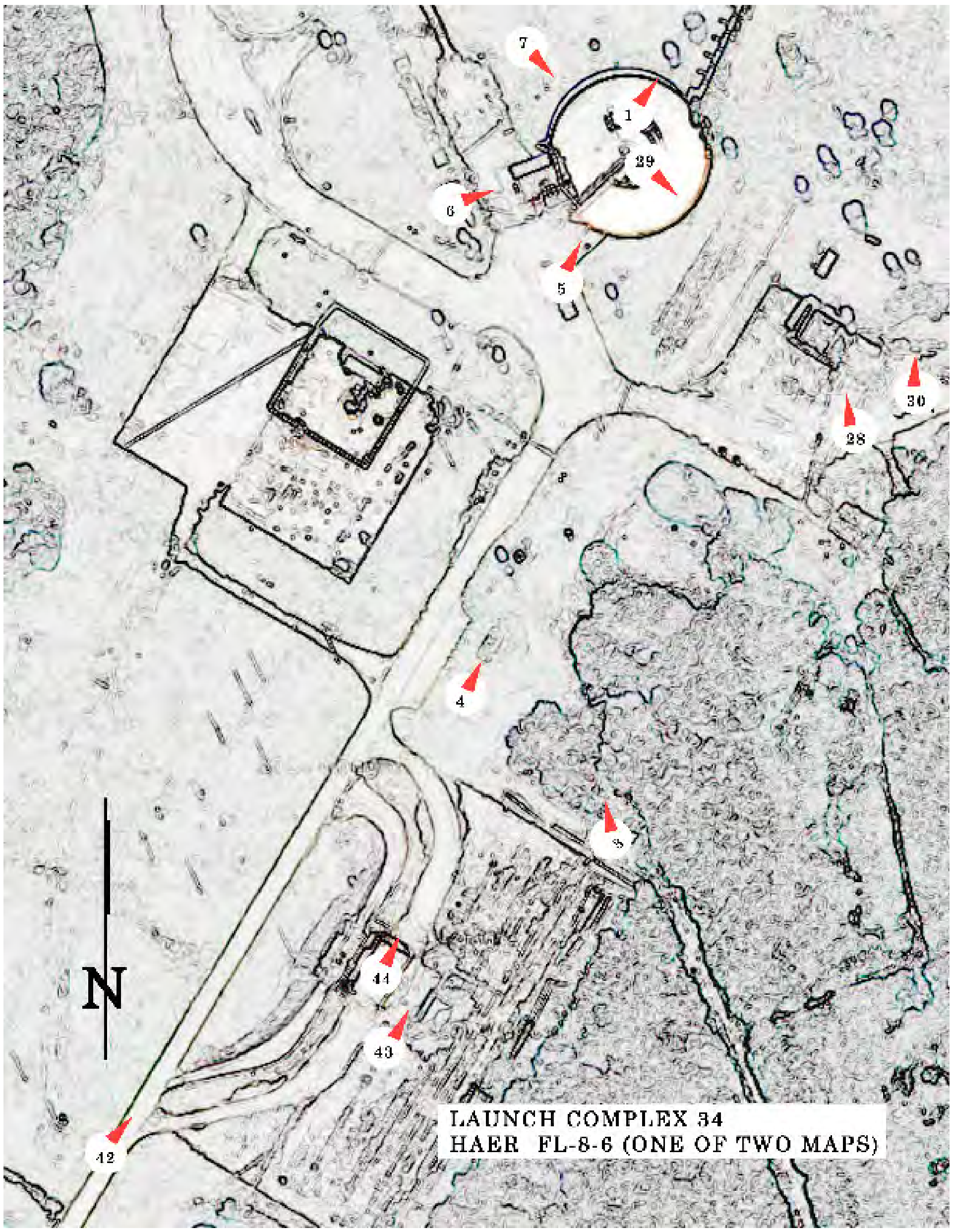
Photographer: Martin Stupich, 2014
See photo key on pages 2 and 3 of Index to Photographs

FL-8-6-D-1	GENERAL VIEW OF BLOCKHOUSE, SOUTHWEST TO NORTHEAST (on photo key as #5)
FL-8-6-D-2	GENERAL VIEW OF “BACK” OF BLOCKHOUSE, VIEW FROM WEST TO EAST (on photo key as #6)
FL-8-6-D-3	BLOCKHOUSE NORTH TO SOUTH (on photo key as #7)



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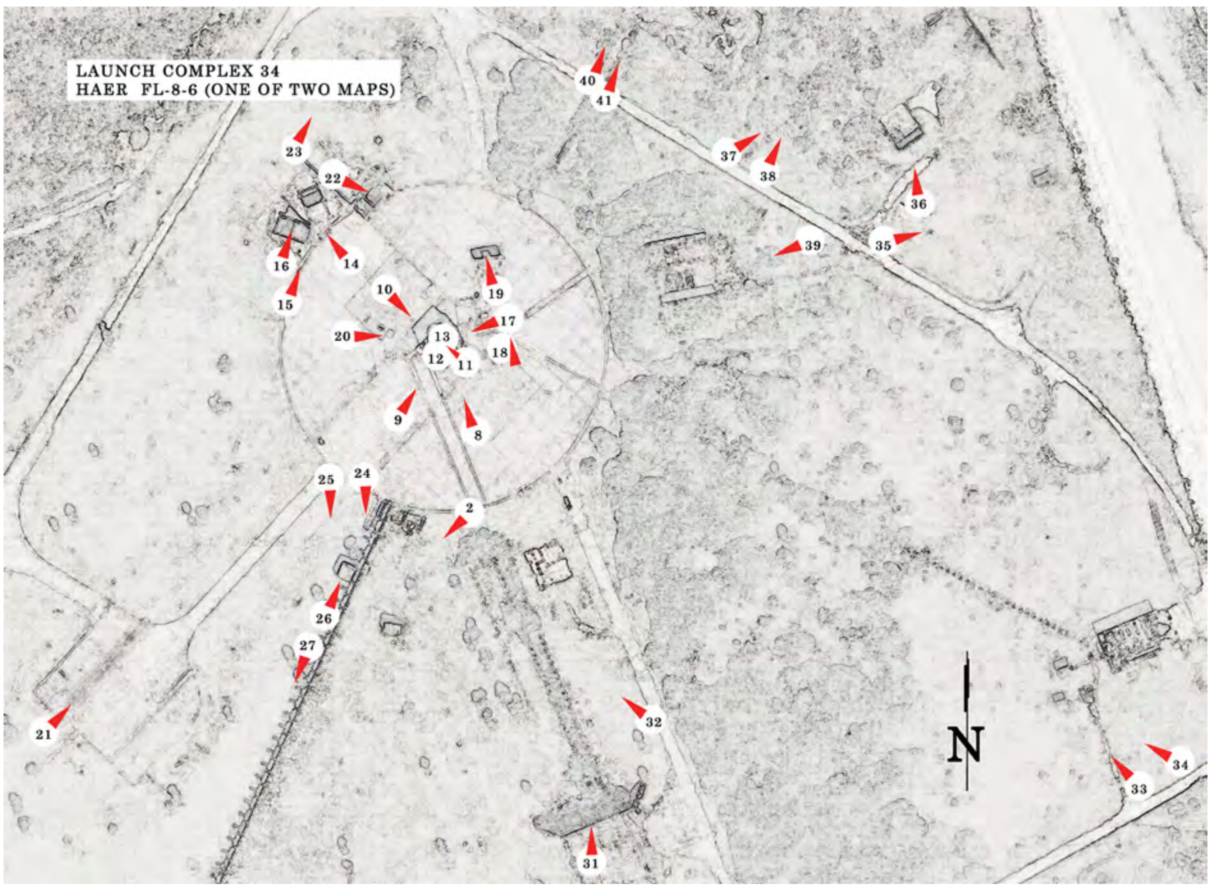

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LAUNCH COMPLEX 34, FACILITY No. 21935
(LAUNCH COMPLEX 34, HIGH PRESSURE GAS STORAGE FACILITY)
17251 Freedom Road
Cape Canaveral
Brevard County
Florida

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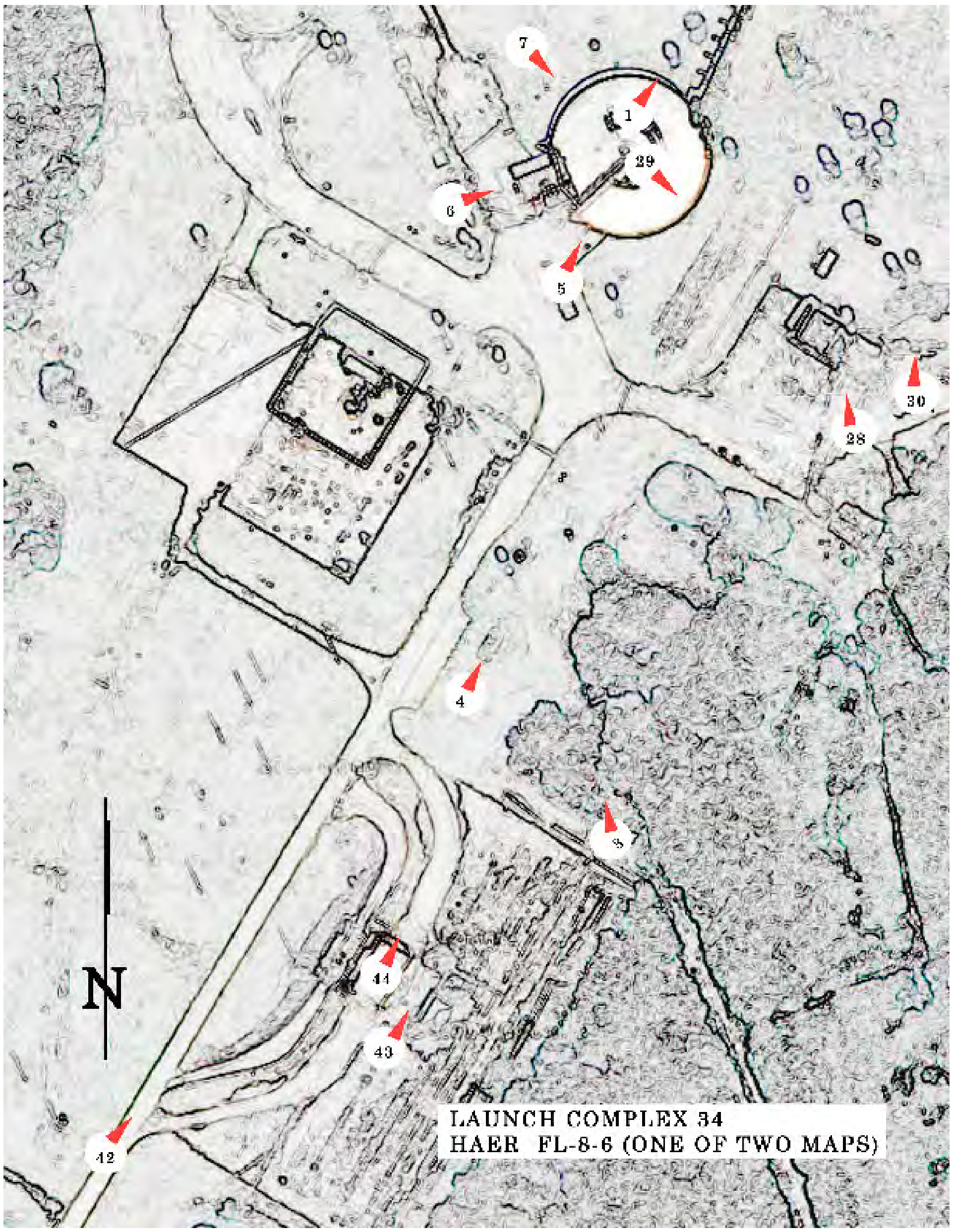
Photographer: Martin Stupich, 2014
See photo key on pages 2 and 3 of Index to Photographs

FL-8-6-E-1	HIGH PRESSURE GAS STORAGE FACILITY, VIEW TO NORTH (on photo key as #28)
FL-8-6-E-2	HIGH PRESSURE GAS STORAGE FACILITY, VIEW FROM BLOCKHOUSE ROOF TO SOUTH (on photo key as #29)
FL-8-6-E-3	BLAST WALL, RESCUE VEHICLE PARKING AREA TO EAST OF HIGH PRESSURE GAS STORAGE FACILITY, VIEW TO NORTH (on photo key as #30)



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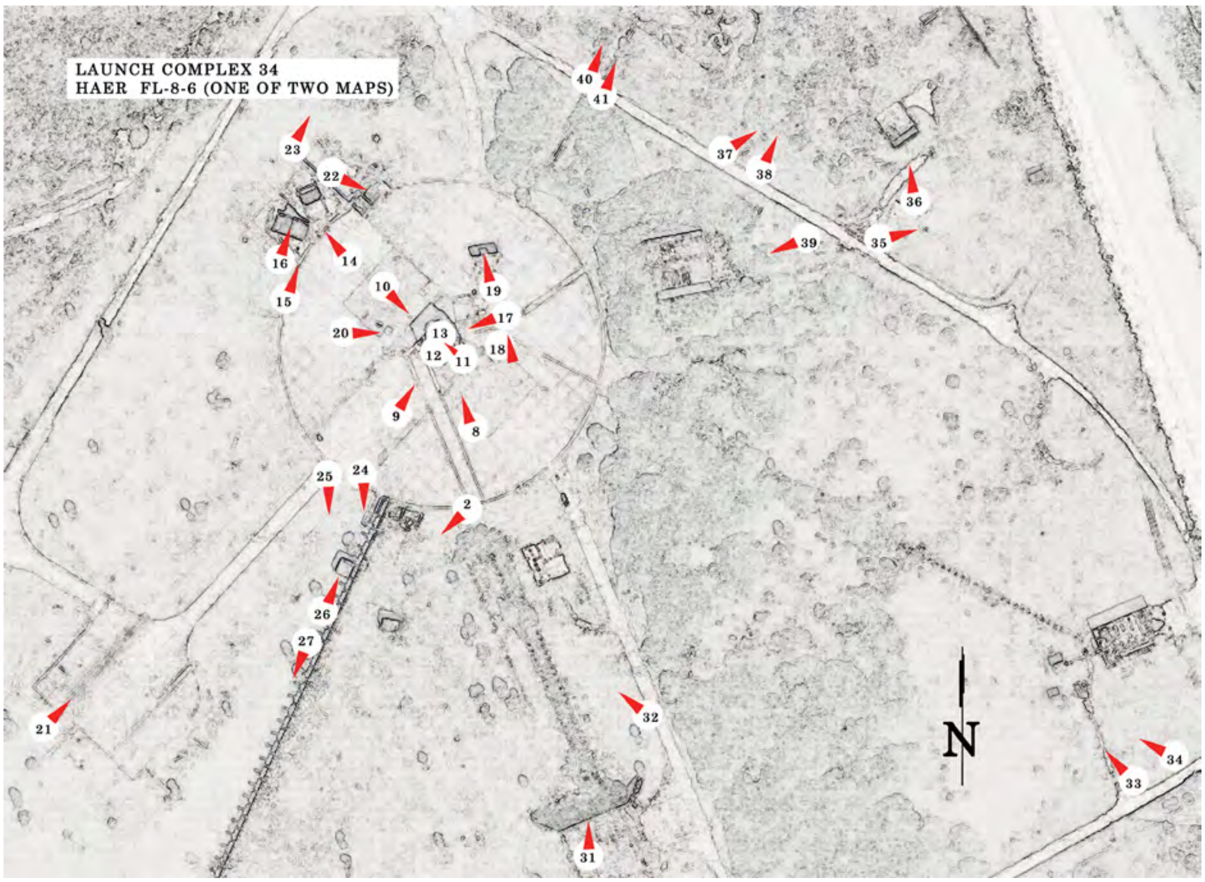

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17251 Freedom Road
Cape Canaveral
Brevard County
Florida

HAER No. FL-8-6-F

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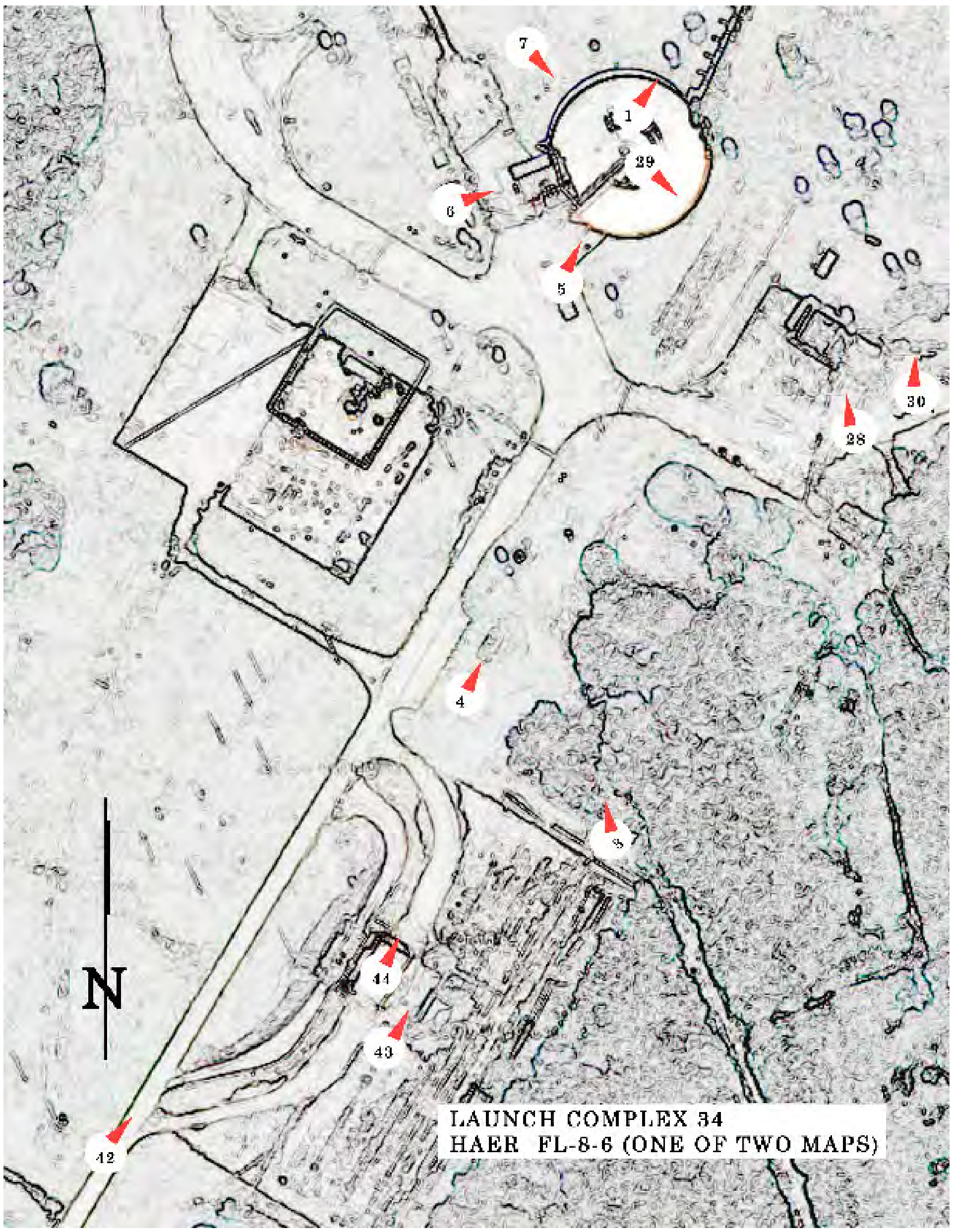
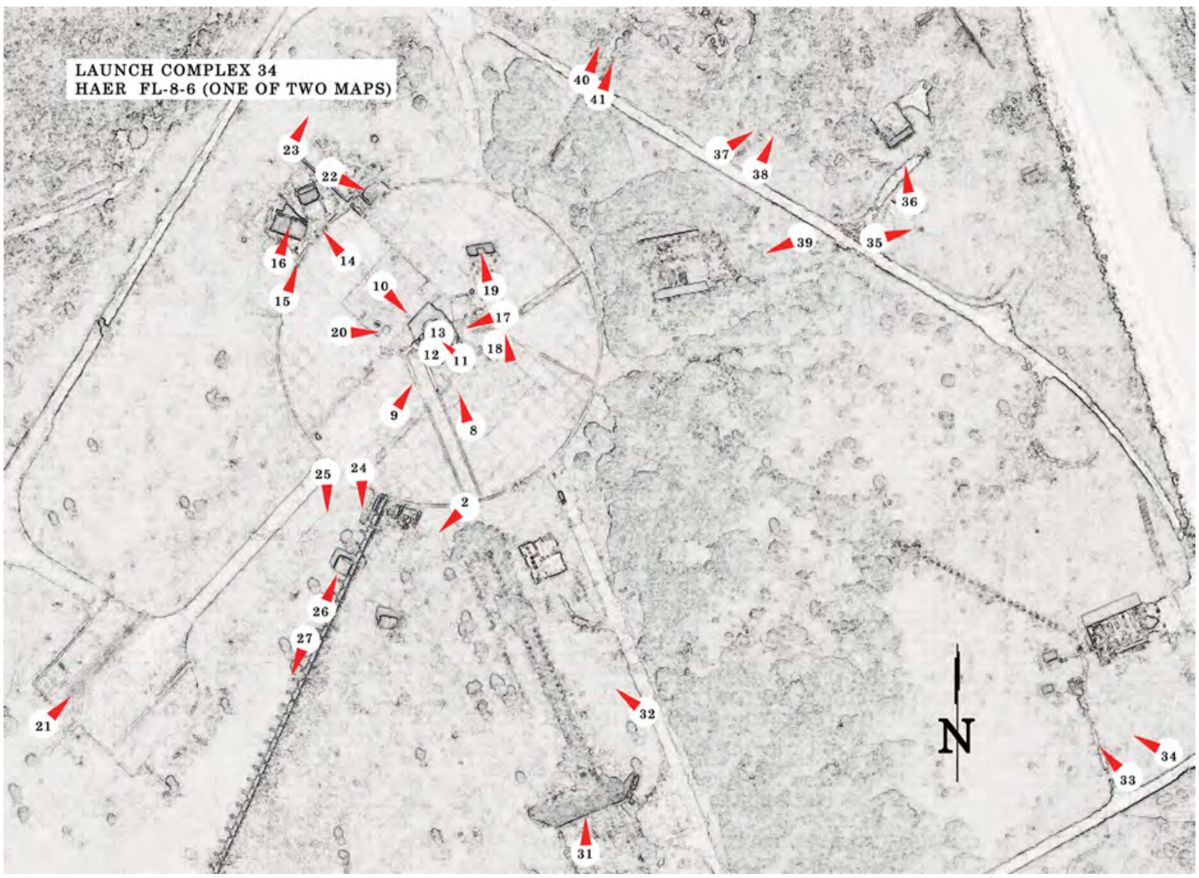
Photographer: Martin Stupich, 2014
See photo key on pages 2 and 3 of Index to Photographs

FL-8-6-F-1	BLAST WALL AT LIQUID OXYGEN FACILITY; VIEW TO NORTH (on photo key as #31)
FL-8-6-F-2	CONCRETE STANCHIONS FOR PIPES FROM LIQUID OXYGEN FACILITY TO PAD; VIEW TO NORTHWEST (on photo key as #32)



Photograph Key 1 for Entire Complex



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17251 Freedom Road
Cape Canaveral
Brevard County
Florida

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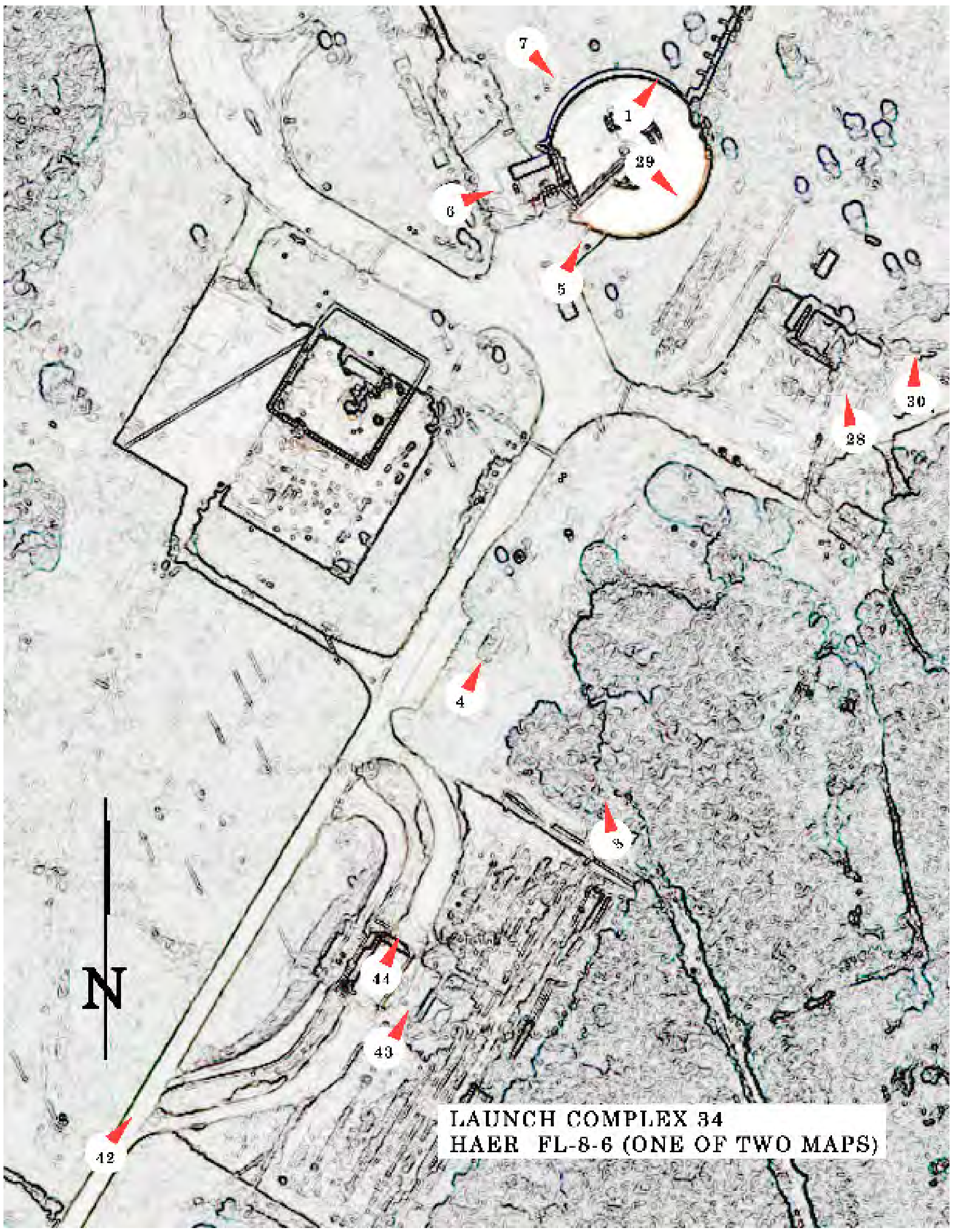
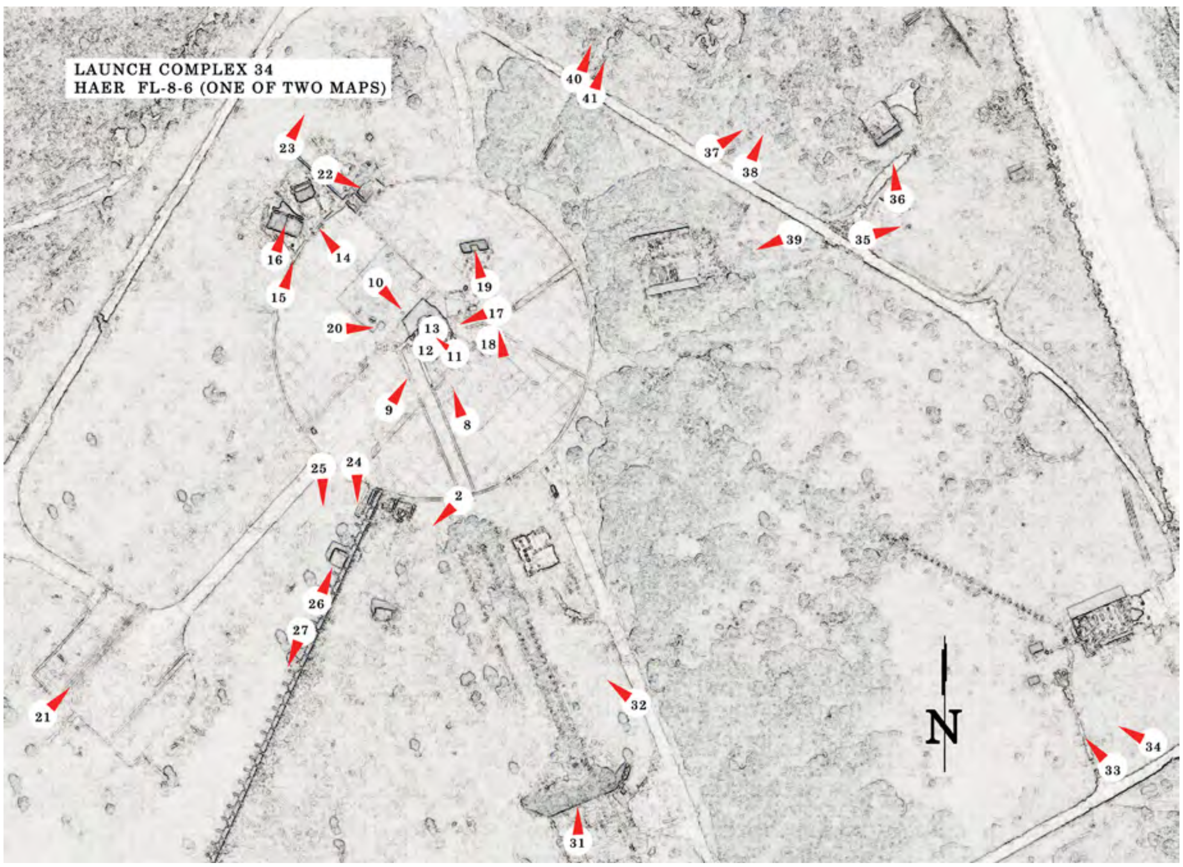
Photographer: Martin Stupich, 2014
See photo key on pages 2 and 3 of Index to Photographs

FL-8-6-G-1	RP-1 FUELSTORAGE FACILITY ON RIGHT, AND SPECIAL LIQUID STORAGE BUILDING ON LEFT; VIEW TO NORTHEAST (on photo key as #33)
FL-8-6-G-2	SPECIAL LIQUID STORAGE BUILDING ON LEFT, AND ELECTRICAL EQUIPMENT BUILDING ON RIGHT; VIEW TO NORTHWEST (on photo key as #34)



Photograph Key 1 for Entire Complex



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17251 Freedom Road
Cape Canaveral
Brevard County
Florida

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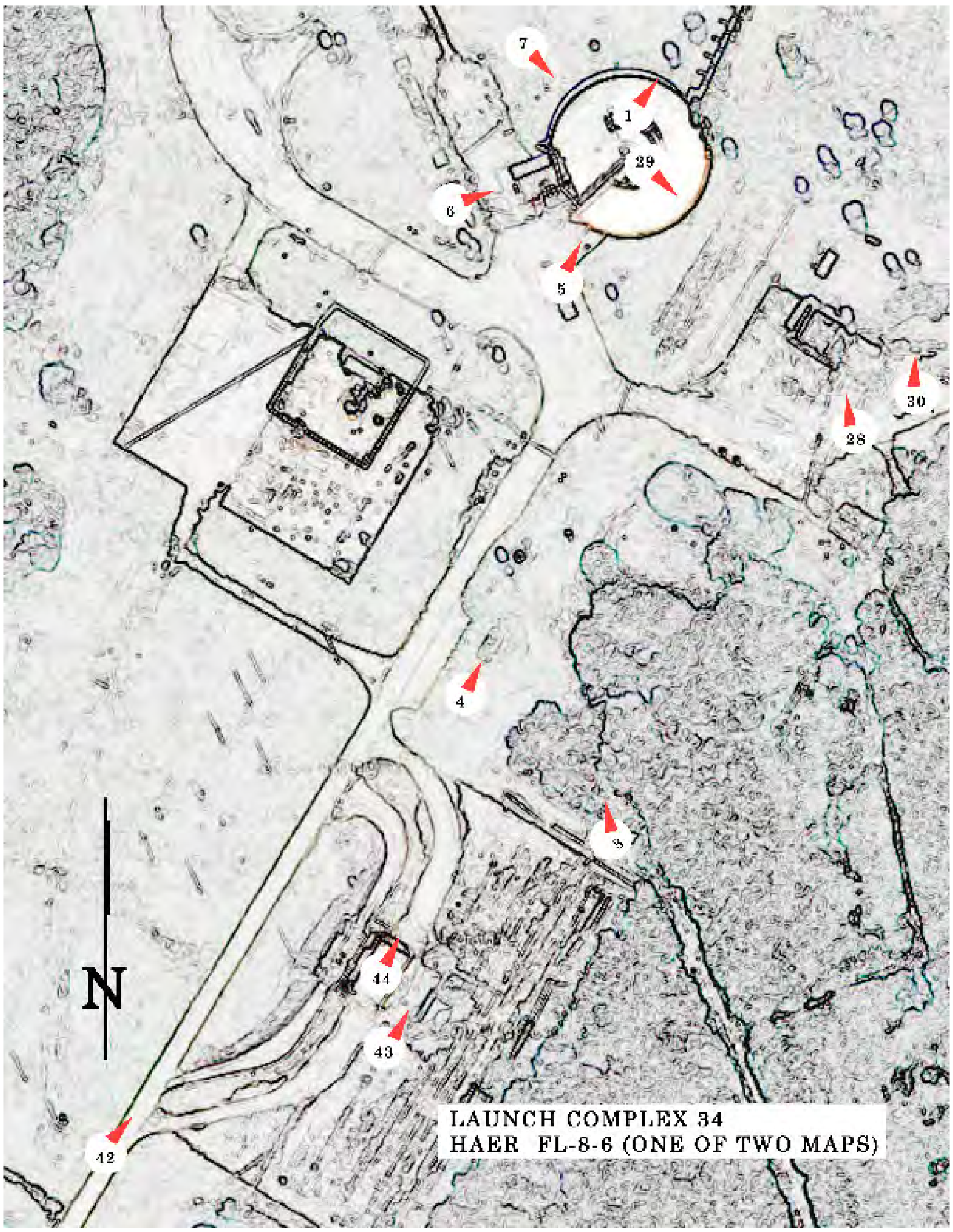
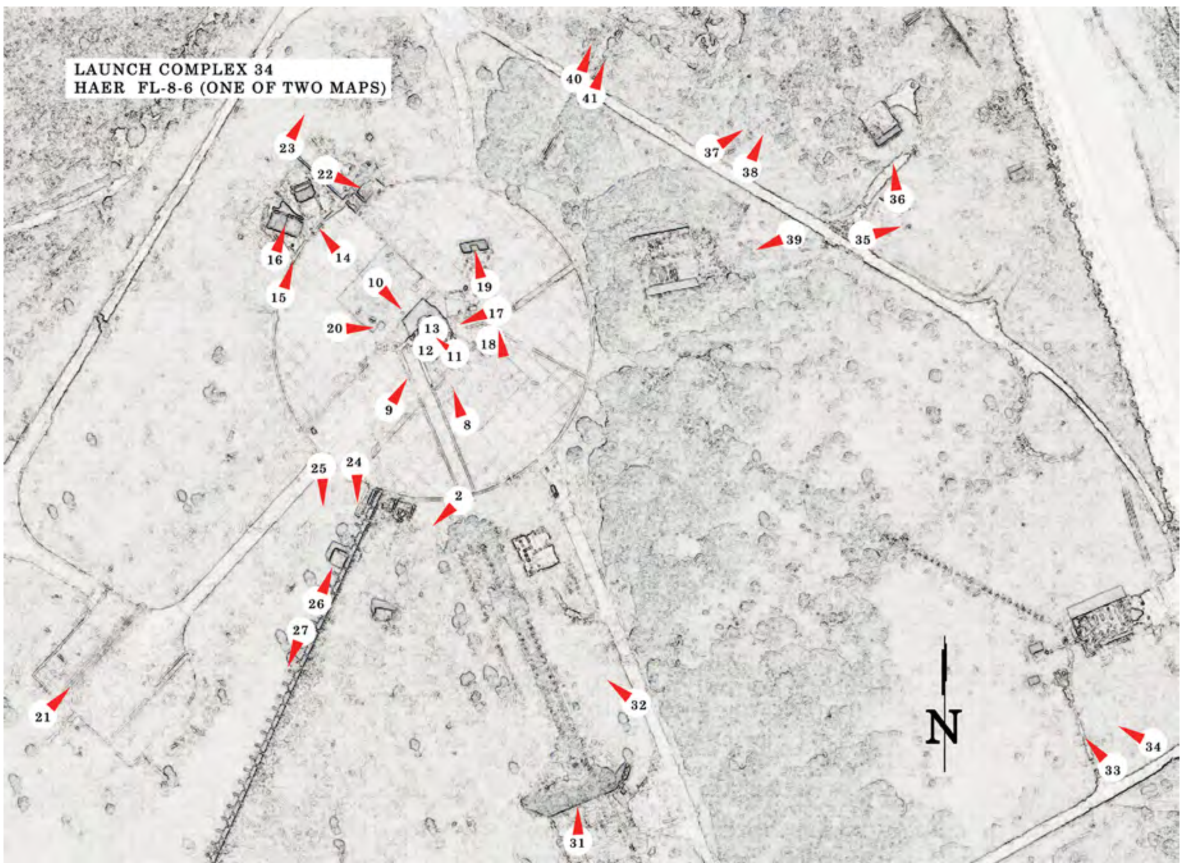
Photographer: Martin Stupich, 2014
See photo key on pages 2 and 3 of Index to Photographs

FL-8-6-H-1	ELECTRICAL EQUIPMENT BUILDING; VIEW TO EAST (on photo key as #35)



Photograph Key 1 for Entire Complex



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(LAUNCH COMPLEX 34, LIQUID HYDROGEN STORAGE FACILITY)
17251 Freedom Road
Cape Canaveral
Brevard County
Florida

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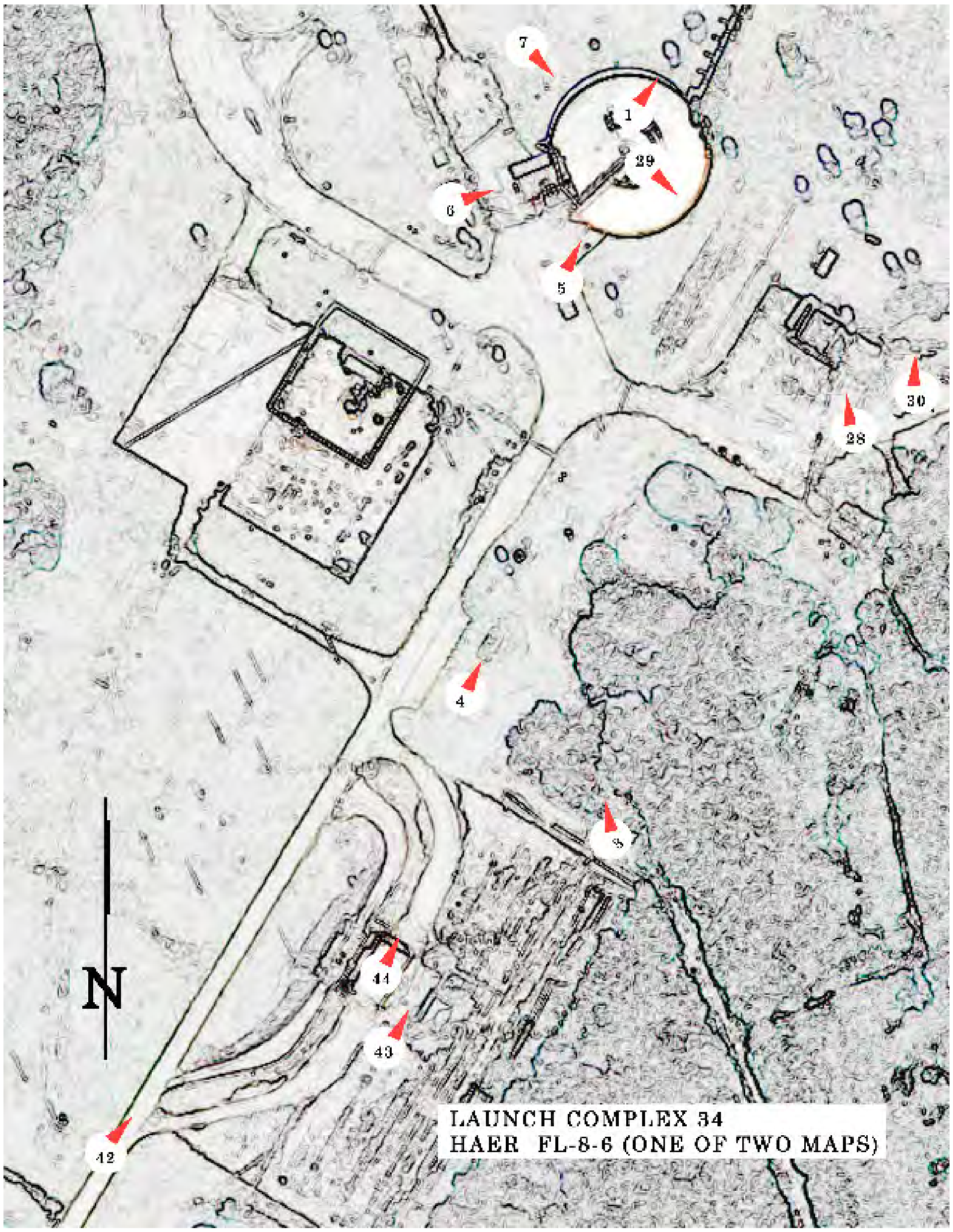
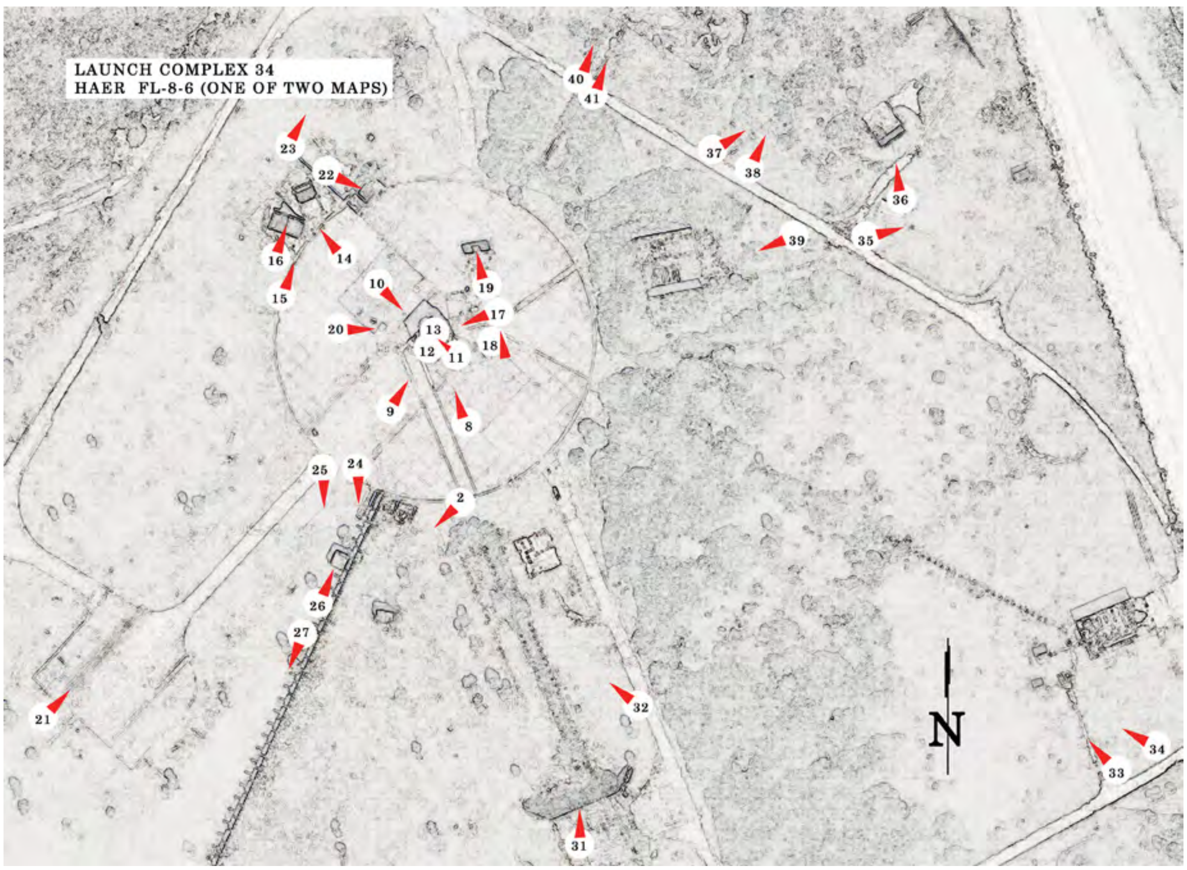
Photographer: Martin Stupich, 2014
See photo key on pages 2 and 3 of Index to Photographs

FL-8-6-I-1	LIQUID HYDROGEN STORAGE FACILITY AND BLAST WALL; VIEW TO NORTHEAST (on photo key as #37)
FL-8-6-I-2	STANCHIONS LEADING FROM LIQUID HYDROGEN STORAGE FACILITY TO PAD; VIEW TO EAST (on photo key as #38)



Photograph Key 1 for Entire Complex



Photograph Key 2 for Entire Complex

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LAUNCH COMPLEX 34, FACILITY No. 21900W
(LAUNCH COMPLEX 34, HIGH PRESSURE HYDROGEN STORAGE FACILITY)
17251 Freedom Road
Cape Canaveral
Brevard County
Florida

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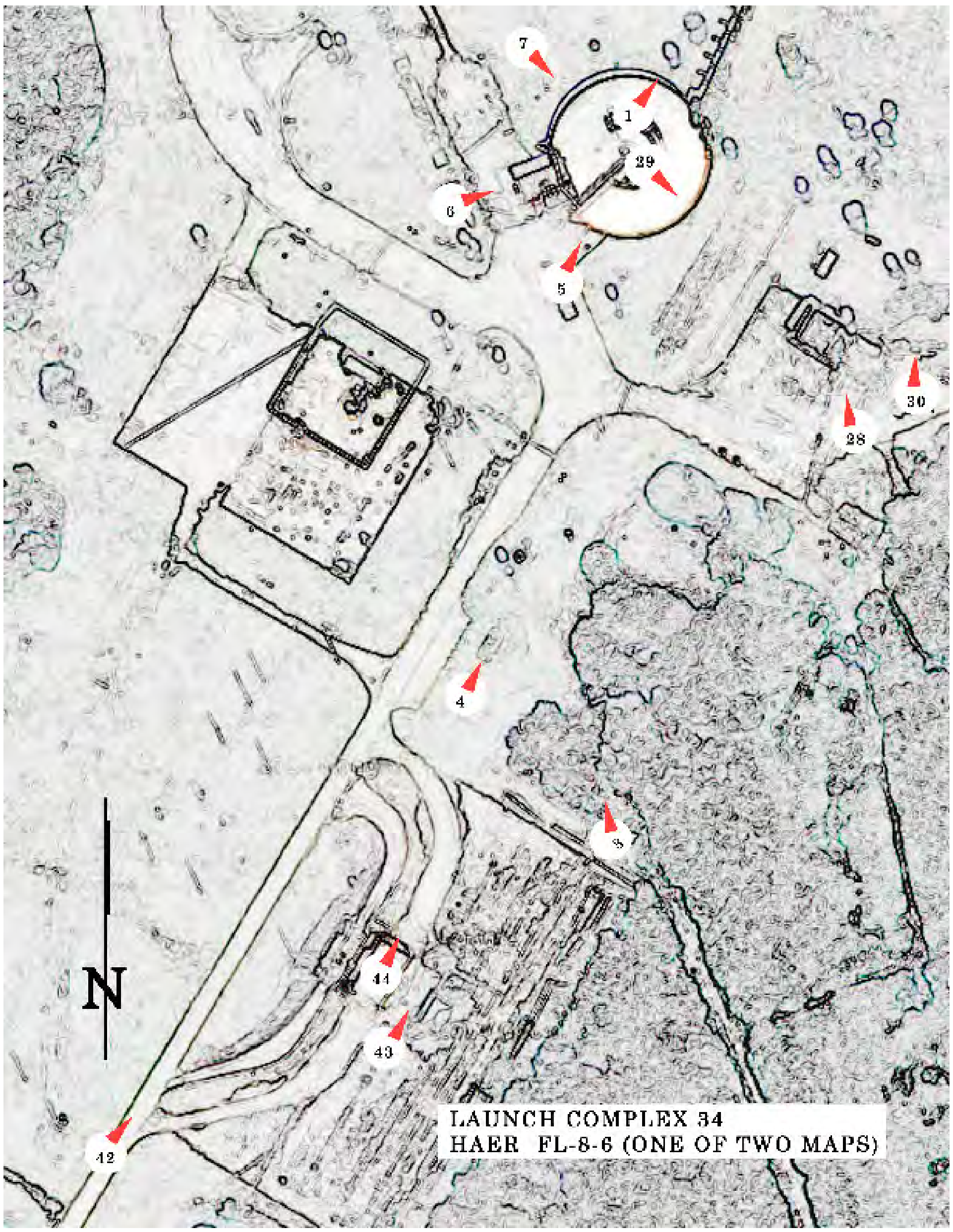
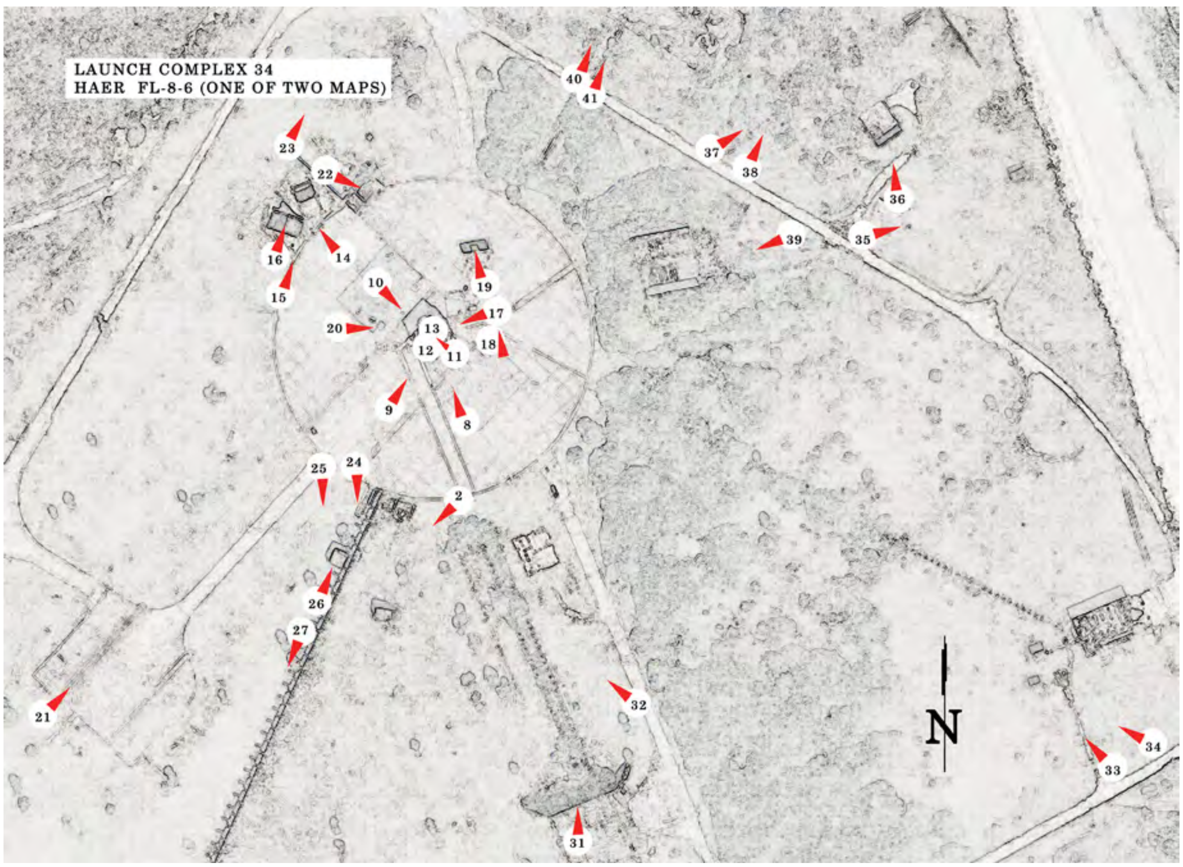
Photographer: Martin Stupich, 2014
See photo key on pages 2 and 3 of Index to Photographs

FL-8-6-J-1	HIGH PRESSURE HYDROGEN STORAGE FACILITY, VIEW TO NORTH (NOTE LC-37 IN BACKGROUND) (on photo key as #36)



Photograph Key 1 for Entire Complex



Photograph Key 2 for Entire Complex

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LAUNCH COMPLEX 34, FACILITY No.21900U
(LAUNCH COMPLEX 34, HIGH PRESSURE GAS BATTERY)
17251 Freedom Road
Cape Canaveral
Brevard County
Florida

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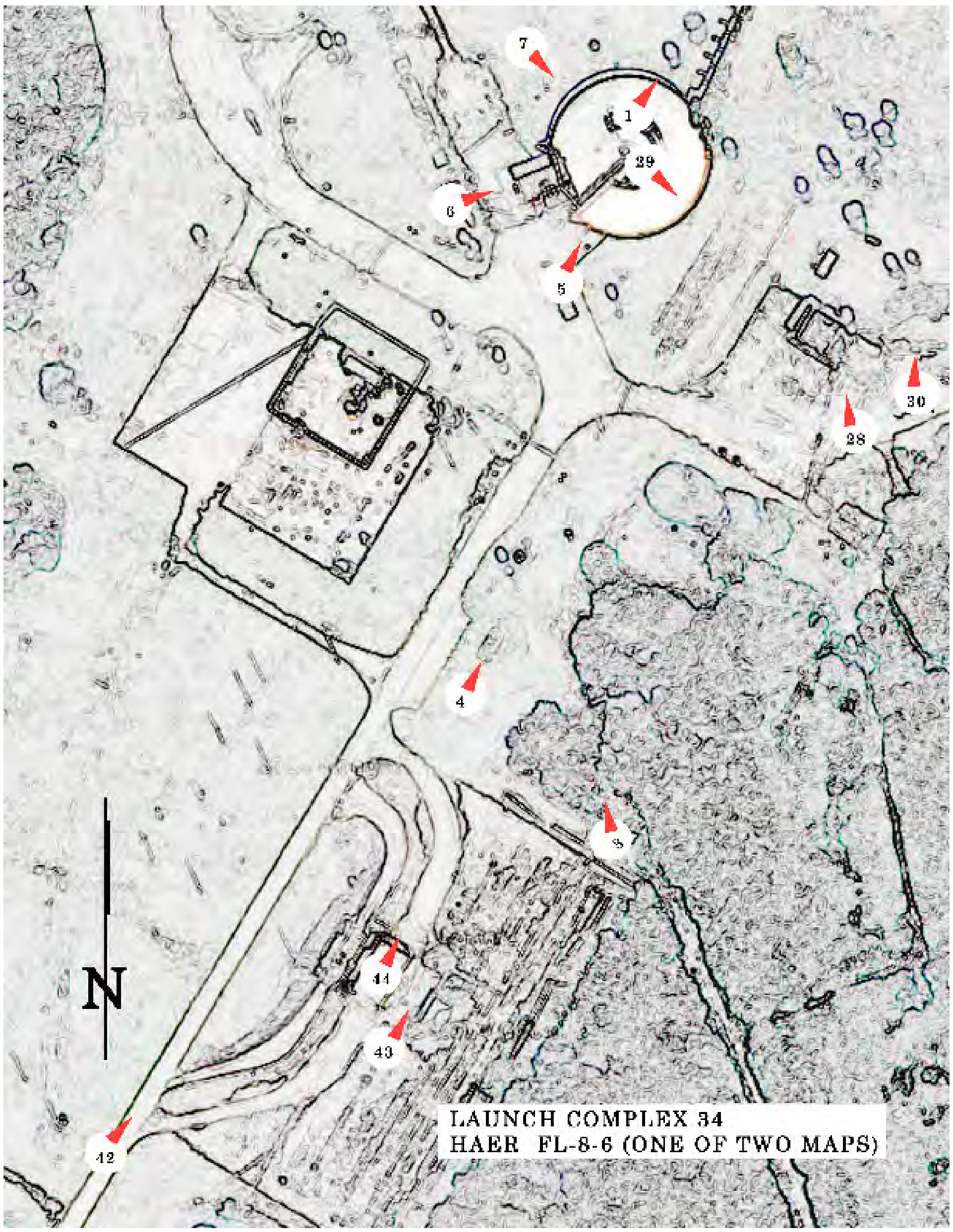
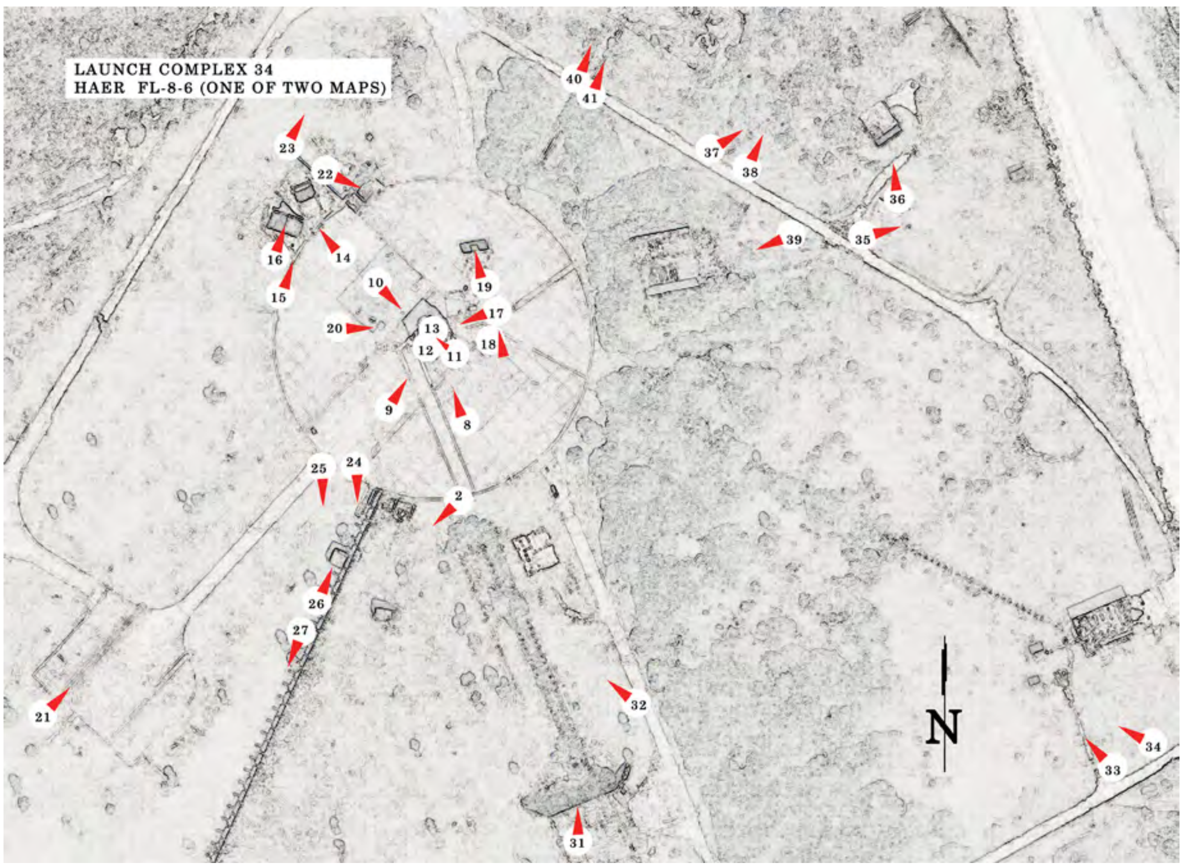
Photographer: Martin Stupich, 2014
See photo key on pages 2 and 3 of Index to Photographs

FL-8-6-K-1	REMNANT WEST WALL OF HIGH PRESSURE GAS BATTERY; VIEW TO WEST (on photo key as #39)



Photograph Key 1 for Entire Complex



Photograph Key 2 for Entire Complex

HISTORIC AMERICAN ENGINEERING RECORD
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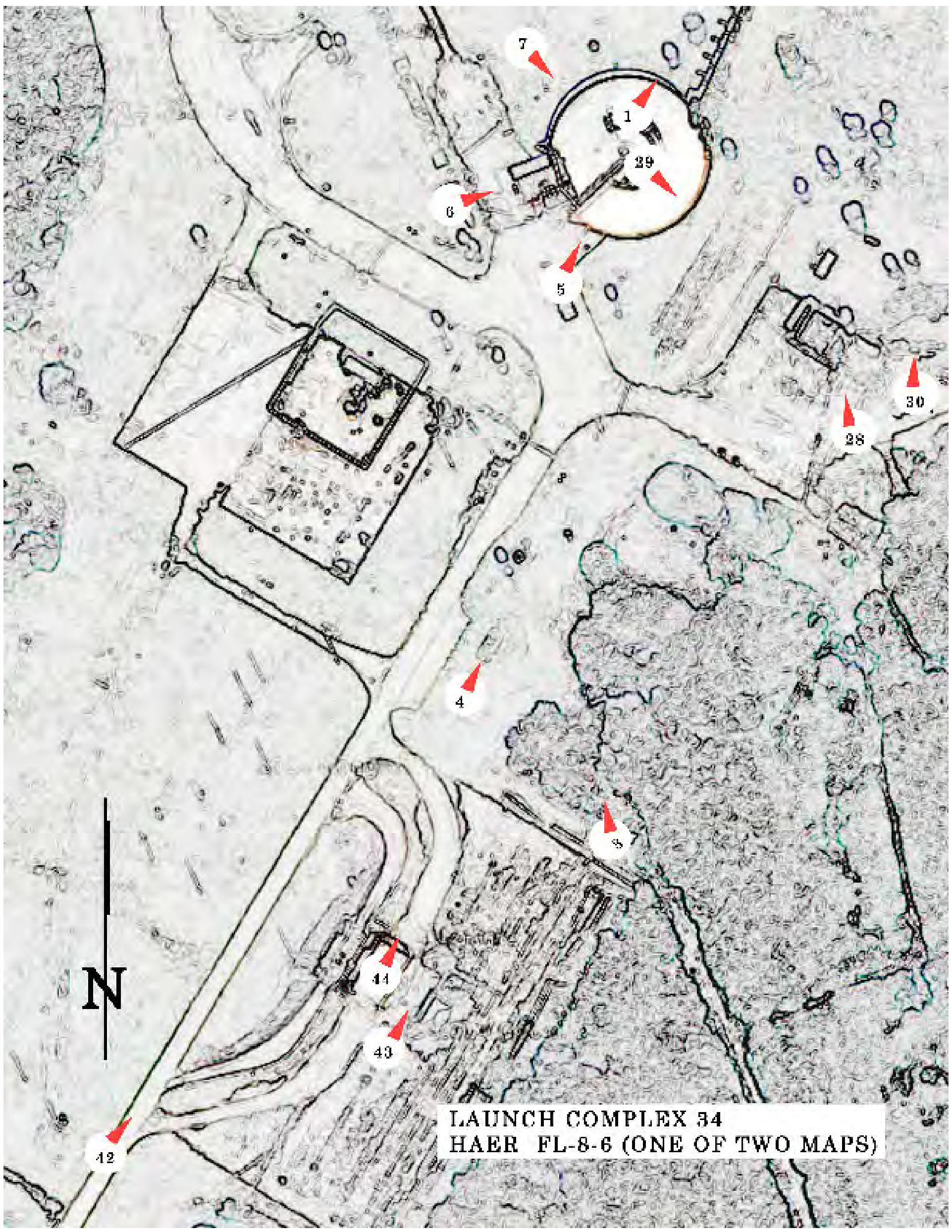
CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 34, FACILITY No. 21900J
(LAUNCH COMPLEX 34, FLUME AND SKIMMING BASIN)
17251 Freedom Road
Cape Canaveral
Brevard County
Florida

HAER No. FL-8-6-L

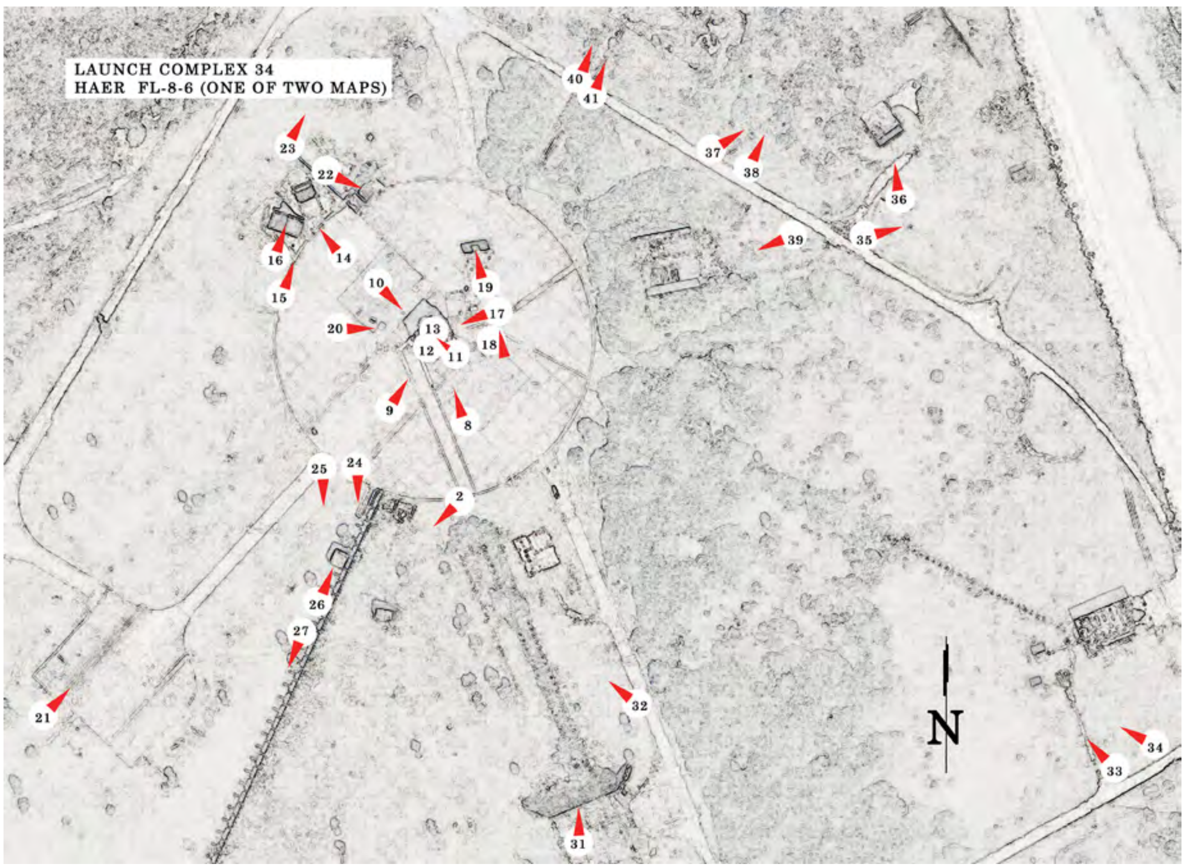
INDEX TO BLACK AND WHITE PHOTOGRAPHS

Photographer: Martin Stupich, 2014
See photo key on pages 2 and 3 of Index to Photographs

FL-8-6-L-1	FLUME AND SKIMMING BASIN, WIDE VIEW SHOWING CONTEXT; VIEW TO EAST (on photo key as #40)
FL-8-6-L-2	FLUME AND SKIMMING BASIN, CLOSER VIEW TO EAST (on photo key as #41)



Photograph Key 1 for Entire Complex



Photograph Key 2 for Entire Complex

HISTORIC AMERICAN ENGINEERING RECORD
CAPE CANAVERAL AIR FORCE STATION
LAUNCH COMPLEX 34
SEE INDEX TO PHOTOGRAPHS FOR CAPTION
HAER No. FL-8-6-L-1

HISTORIC AMERICAN ENGINEERING RECORD
CAPE CANAVERAL AIR FORCE STATION
LAUNCH COMPLEX 34
SEE INDEX TO PHOTOGRAPHS FOR CAPTION
HAER No. FL-8-6-L-2

HISTORIC AMERICAN ENGINEERING RECORD

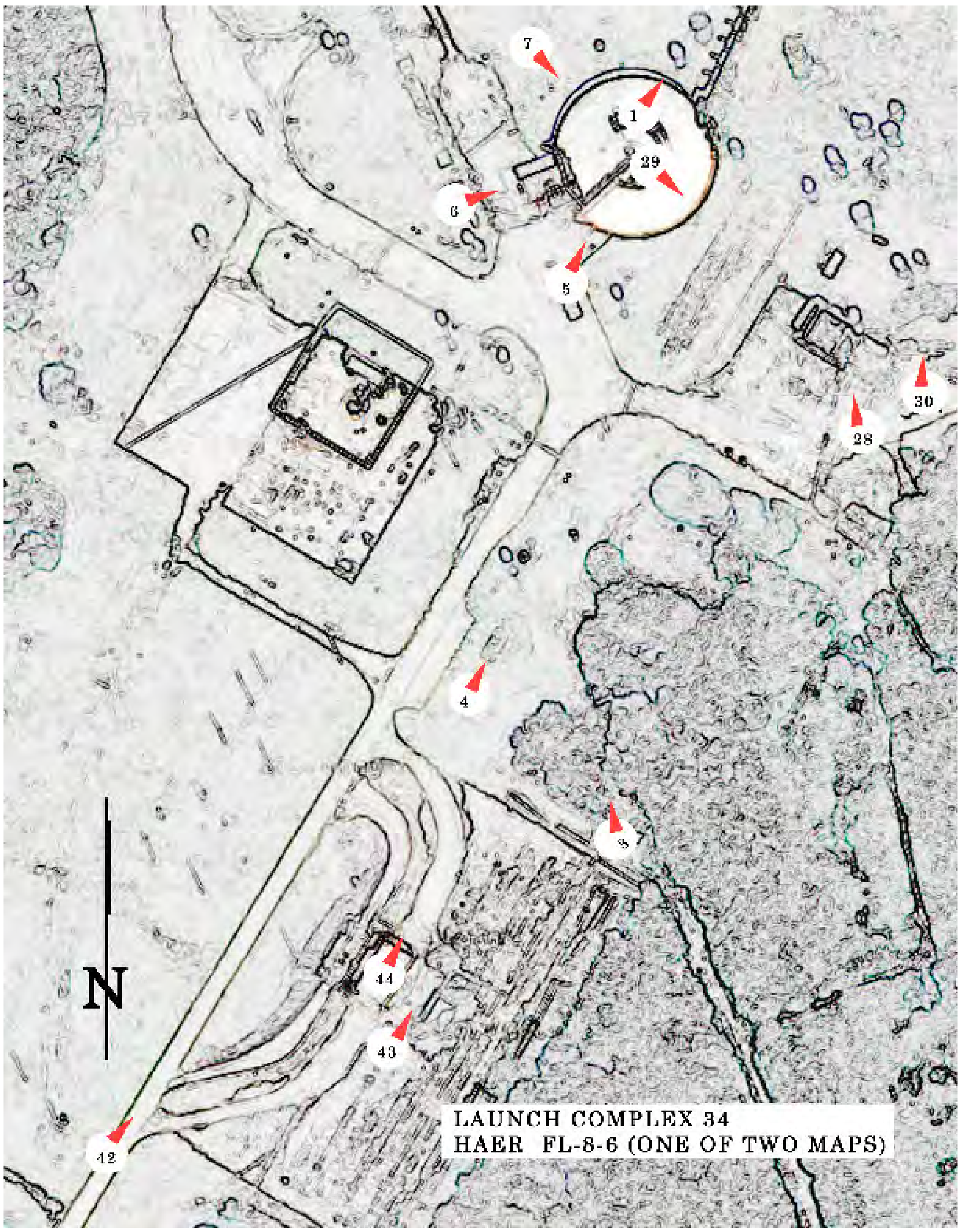
INDEX TO PHOTOGRAPHS

CAPE CANAVERAL AIR FORCE STATION, HAER No. FL-8-6-M
LAUNCH COMPLEX 34, FACILITY No. 22003
(LAUNCH COMPLEX 34, PHASED ARRAY RADAR PEDESTAL BERM)
17251 Freedom Road
Cape Canaveral
Brevard County
Florida

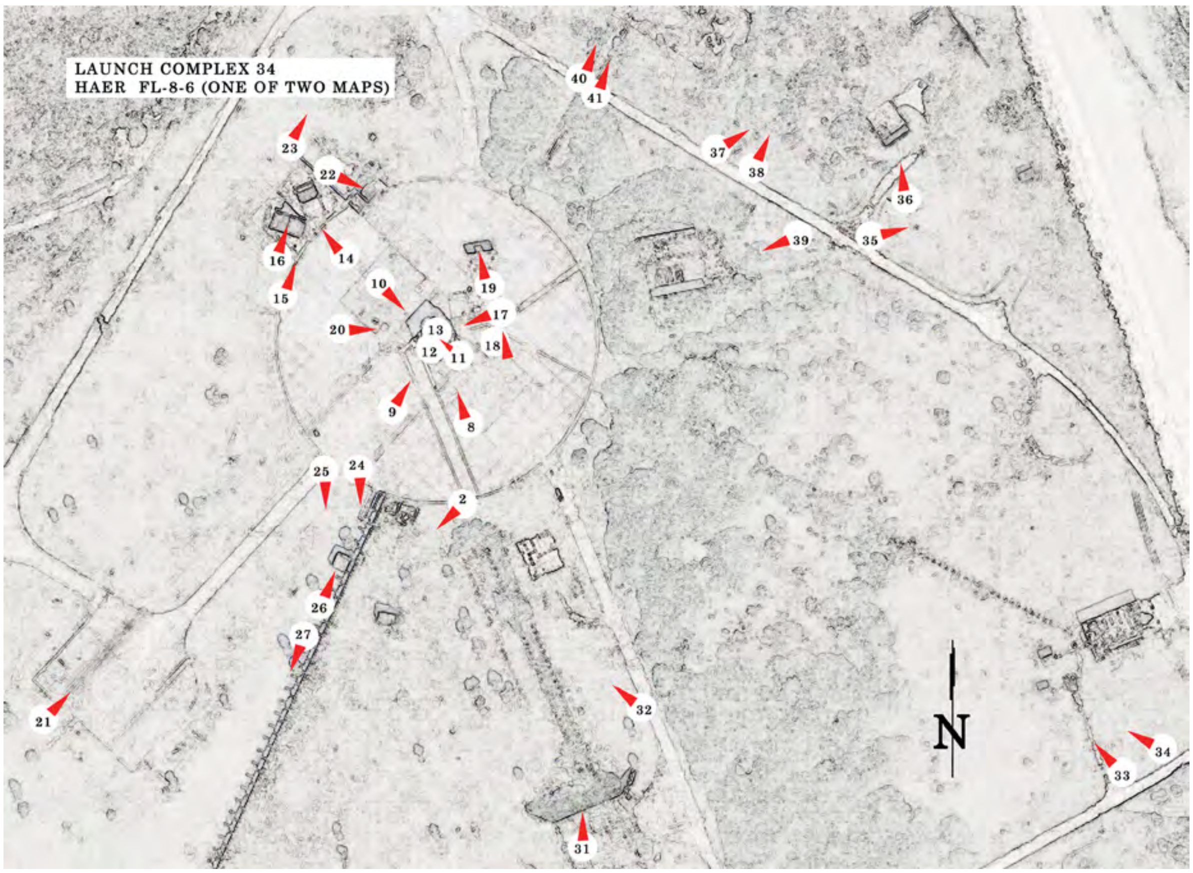
INDEX TO BLACK AND WHITE PHOTOGRAPHS

Photographer: Martin Stupich, 2014
See photo key on pages 2 and 3 of Index to Photographs

FL-8-6-M-1	PHASED ARRAY RADAR PEDESTAL BERM, VIEW TO EAST (on photo key as #42)
FL-8-6-M-2	PHASED ARRAY RADAR PEDESTAL BERM SHOWING SOUTH SIDE, VIEW TO EAST (on photo key as #43)
FL-8-6-M-3	PHASED ARRAY RADAR PEDESTAL ATOP BERM SHOWING CONCRETE PAD AND MOUNTING PAD, VIEW TO EAST (on photo key as #44)



Photograph Key 1 for Entire Complex



Photograph Key 2 for Entire Complex

HISTORIC AMERICAN ENGINEERING RECORD
CAPE CANAVERAL AIR FORCE STATION
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14. ABSTRACT

This report presents Historic American Engineering Record (HAER) Level II documentation of Launch Complexes 1/2, 3/4, 9/10, 14, and 34, Cape Canaveral Air Force Station (CCAFS), Florida. These facilities have played an important role in the American missile and manned space programs that began largely as a result of the Cold War. As the "arms race" expanded in the 1950s and 1960s, missile systems with increasing range and destructive power were deployed on both American and foreign soil. To bring these systems to operational readiness, long and complicated testing programs were necessary and required specialized facilities to support them. A national effort to put men on the surface of the moon also required specialized facilities at Cape Canaveral. These five complexes were constructed in the 1950s and early 1960s, with Launch Complexes 1/2, 3/4, and 9/10 used exclusively for rocket and missile testing, and Launch Complexes 14 and 34 also used for manned spaceflight. Launch Complexes 14 and 34 are part of the Cape Canaveral Air Force Station National Historic Landmark District established in 1984.

15. SUBJECT TERMS
Historic American Engineering Record (HAER), Cape Canaveral Air Force Station (Fla.), Historic buildings--United States, Cold War, Guided missiles–Testing–United States, Launch complexes (Astronautics)–Florida–Cape Canaveral, Historic Preservation, Cultural property–Protection, National Register of Historic Places (NRHP)

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